The Gemmological Laboratory Book
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Foreword

CIBJO is the French acronym for the Confédération Internationale de la Bijouterie, Joaillerie, Orfèvrerie, des Diamants, Perles et Pierres, which translates as the International Confederation of Jewellery, Silverware, Diamonds, Pearls and Stones (normally shortened to the International Jewellery Confederation). Founded in 1926 as BIBOAH, a European organisation whose mission was to represent and advance the interests of the jewellery trade in Europe, it was reorganised in 1961 and renamed CIBJO, in 2009 it was once again reorganised and officially named “CIBJO, The World Jewellery Confederation”. Today CIBJO, which is domiciled in Switzerland, is a non-profit confederation of national and international trade associations including commercial organisations involved in the jewellery supply chain. It now has members from countries representing all five continents of the world. CIBJO printed its first deliberations on terminology and trade practices in 1968.

It is the task of CIBJO to record the accepted trade practices and nomenclature for the industry throughout the world. The records of the trade practices complement existing fair trade legislation of a nation or in the absence of relevant national laws they can be considered as trading standards. In countries where laws or norms exist, which conflict with the laws, norms or trade practices in other countries, CIBJO will support the national trade organisations to prevent trade barriers developing. The purpose of CIBJO is to encourage harmonisation, promote international co-operation within the jewellery industry, consider issues which are of concern to the trade worldwide and to communicate proactively with members. Foremost amongst these the aim is to protect consumer confidence in the industry. CIBJO pursues all of these objectives through informed deliberation and by reaching decisions in accordance with its Statutes. CIBJO relies upon the initiative of its members to support and implement its standards, and to protect the trust of the public in the industry.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The work of CIBJO is accomplished through Committees, Commissions and Sectors. Committees and Commissions consider standards for use in the jewellery supply chain. Sectors represent levels of trade in the jewellery industry. Sectors and commissions advise the Executive Committee on current trade practices and issues that affect the jewellery industry.

Three independent sectors exist within the confederation:

Sector A — The Products Sector

Sector B — The Supply Chain Sector

Sector C — The Service Sector

The Executive Committee may appoint Commissions that consider detailed issues. At present these are:

Coloured Stone

Coral
Diamond

Ethics

Gemmological

Pearl

Marketing & Education

Precious Metals

World Jewellers Vigilance

The Commissions for Diamonds, Gemstones, Pearls and Precious Metals have collated the guidelines, which present the accepted trade practices for applying descriptions to these materials. It is in the best interest of all those concerned to be aware of them.

The Sectors and Commissions will propose changes in the standards, also known as the Blue Books, to the Executive Committee. After review the Executive Committee will submit the accepted proposals for adoption to the Board of Directors and if approved they will notify the assembly of delegates of the changes at the annual congress. Furthermore, it is our mutual responsibility to support these recommendations, which concern all professional people connected with diamonds, gemstones, pearls and precious metals. CIBJO Standards are subject to government regulations in the respective jurisdictions of CIBJO members.

The national umbrella organisation for each country represents, in principle, all the national trade organisations involved in the sectors mentioned above. This democratic structure, which has contributed to CIBJO’s world-wide recognition also includes international trade and commercial organisations, it provides an international forum for the trade to collectively draw attention to issues and implement resulting decisions.

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Introduction

The CIBJO Gemmological Laboratory Book is intended as a source of information and recommendations for gemmological laboratories on which they may choose to base their activities in order to ensure proper quality control and accountability within their Gemmological Laboratory.

The work of a Gemmological Laboratory and the test results it produces are reliant upon good practices throughout the Gemmological Laboratory’s operation, from the first to the last interaction with the Customer.

The following definitions apply in understanding how to implement CIBJO Blue Books and some of its normative references, e.g. when applicable ISO standards.

- “shall” indicates a requirement;
- “should” indicates a recommendation;
- “may” is used to indicate that something is permitted;
- “can” is used to indicate that something is possible.

The Gemmological Commission strongly recommends that all Gemmological Laboratories aspire to achieve the highest possible level of accountability throughout their operations and that the best practices recommended in the CIBJO Gemmological Laboratory Book are followed as a minimum. However, ideally all Gemmological Laboratories should also consider the application of ISO/IEC 17025.

The Gemmological Commission

October 2016
CIBJO Guidelines for Gemmological Laboratories

This book takes its concept from ISO/IEC 17025, an International Standard for which it is recommended that all Gemmological Laboratories seriously consider compliance.

Disclaimer — CIBJO recommends the best practices but is not responsible for gemmological reports issued by a Laboratory.

1. Scope

This CIBJO Gemmological Laboratory Book suggests best practices and general requirements for the competence to carry out tests, grading and/or internal calibrations, on instruments, coloured gemstones, diamonds and pearls within gemmological laboratories. The clauses herein are a guide only and shall not be regarded or considered as rules of application, laws, or statutes that govern the operation of gemmological laboratories.

The CIBJO Gemmological Laboratory Book suggests best practices for testing, grading and internal calibration performed using those methods both typically used and within gemmological laboratories as well as those uniquely developed. The suggestions are pertinent to the operations of all gemmological laboratories that issue test results regardless of whether or not these are part of a service that is paid for by a customer. They are also pertinent regardless of a gemmological laboratory’s size and scope.

When a gemmological laboratory does not undertake one or more of the activities covered by this CIBJO Gemmological Laboratory Book, the suggestions stated in those clauses may not apply.

This CIBJO Gemmological Laboratory Book is for use by gemmological laboratories in developing their management system for quality, administrative and technical operations. It is not intended nor should it be considered as a guarantee for the quality of results issued by the laboratories.

Gemmological laboratories should refer to the appropriate International standards when organising compliance with safety requirements for the operation of gemmological laboratories: these are not covered in the CIBJO Gemmological Laboratory Book.

2. Normative references

The following referenced documents are recommended readings. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories. See: https://www.iso.org/standard/66912.html

The Coral Book, CIBJO, International Confederation of Jewellery, Silverware, Diamonds, Pearls and Stones, the World Jewellery Confederation, Viale Berengario, 19, 20149 Milano, Italy. cibjo@cibjo.org

The Diamond Book, CIBJO, International Confederation of Jewellery, Silverware, Diamonds, Pearls and Stones, the World Jewellery Confederation, Viale Berengario, 19, 20149 Milano, Italy cibjo@cibjo.org.

The Gemstone Book, CIBJO (International Confederation of Jewellery, Silverware, Diamonds, Pearls and Stones), the World Jewellery Confederation, Viale Berengario, 19, 20149 Milano, Italy cibjo@cibjo.org.

The Pearl Book, CIBJO (International Confederation of Jewellery, Silverware, Diamonds, Pearls and Stones), the World Jewellery Confederation, Viale Berengario, 19, 20149 Milano, Italy cibjo@cibjo.org.

The Precious Metals Book, CIBJO (International Confederation of Jewellery, Silverware, Diamonds, Pearls and Stones), the World Jewellery Confederation, Viale Berengario, 19, 20149 Milano, Italy cibjo@cibjo.org.

3. Terms and definitions

3.1. Audit
examination of the quality, state, efficiency of an organisation, system, process, project or product to ascertain its validity and reliability.

3.2. Calibration
a set of graded measurements that show position or values to mark or correct the units of measurements of an instrument.

3.3. Certificate
a document of a legal standing.

3.4. Certified reference materials — CRMs
reference materials, accompanied by documentation issued by an authoritative body and providing one or more specified property values with associated uncertainties and traceability, using valid procedures.

3.5. Competent subcontractor
a contractor of the primary contractor, in this case the laboratory, who by virtue of their knowledge, experience and equipment is competent to do the work.

3.6. Gem materials
those materials listed in the CIBJO, Diamond, Pearl, and Gemstones Books (see 2, Normative References).
3.7. Gemmological laboratory

an establishment that provides controlled conditions in which the identification, authentication and grading of gem materials may be performed; scientific research, experiments and measurements may be carried on as well with the aim of a better knowledge of gem materials.

3.8. Gemmology

the science, art and profession of identifying, authenticating, researching and grading gem materials.

3.9. Gemmological laboratory

an alternative (American English) spelling for gemmological laboratory.

3.10.Gemology

an alternative (American English) spelling for gemmology

3.11.Grading

the classification of technical/commercial characteristics of gem materials

3.12.Internal audit

control of the Laboratory’s quality system, to ensure that the activities carried out in the Laboratory are in conformity with the established policies and procedures of the management system, with the aim of correcting any non-conformities and introducing improvements. The final outcome is to minimize the percentage of errors and give valid, consistent and reliable results and services.

3.13.Internal calibrations

calibrations done in a Centre on its own instruments, to check their validity and consistency with the Standards.

3.14.Laboratory / Lab

trade short form for a gemmological laboratory, see 3.7 and 3.9.

3.15.Quality and technical record

written notes on facts related to quality and/or to technical items so that they can be remembered or referred to in the future.

3.16.Reference standards and reference materials

references calibrated by a body that can provide traceability, used to establish, by comparison, the value of physical or chemical properties.
3.17. Report

a description of technical/commercial characteristics of gem materials in accordance with the rules relative to CIBJO international agreements.

3.18. Sampling

a defined procedure whereby a part of a substance, a material, a product or a lot is taken to provide for testing of a representative sample of a whole. Sampling procedures describe the selection, sampling plan, withdrawal and preparation of a sample or samples from a substance, material, product or a lot, to yield the required information.

3.19. SI units – International System of Units

an internationally agreed system of measurement that uses seven base units (length, mass, time, electric current, thermodynamic temperature, luminous intensity and amount of substance) with two supplementary units (plane angle and solid angle).

3.20. Subcontract

a contract that assigns some of the obligations of a prior contract to another party.

3.21. Test

a procedure in which technical characteristics of gem materials are observed, measured, analysed and established.

3.22. Traceability

completeness of the information about every step in a process chain.

3.23. Reproducibility of results

ability of a gemmological laboratory to get the same results when repeating tests, using the same reference samples and standards.

4. Management requirements

4.1. Organisation

4.1.1. The gemmological laboratory, the organisation, or commercial company of which it is part shall be legally responsible for the activities of the gemmological laboratory. The management system shall cover work carried out by the gemmological laboratory whether inside or outside the political/administrative borders of its registration.

4.1.2. In order to make clear any implied or potential conflicts of interest, if a gemmological laboratory is entirely or partly owned by, or has investors within a gem material (loose or mounted) trade organisation or a commercial company that trades in gem materials (loose or mounted), in particular where traders or potential customers are on a board(s) and may play a role in, or have an influence upon the testing and/or reporting
activities of the gemmological laboratory; the responsibilities of key personnel in the organisation that have such involvement or influence shall be clearly defined, and openly declared to the Laboratory’s clients.

4.1.3. A gemmological laboratory should be able to demonstrate that it is impartial and that it and its personnel are free from any undue commercial, financial and other pressures which might influence their technical judgement. The gemmological laboratory should not engage in any activities that may endanger the trust in its independence of judgement and integrity in relation to its testing or internal calibration activities.

4.1.4. The gemmological laboratory management system shall ensure that gemmological laboratory personnel are free from any internal and external pressures and influences that may interfere with the quality of their work; the performance of tests, grading and/or instrument calibrations. The management system shall have personnel in-place that monitor such influences and when necessary have the power to take corrective action.

4.1.5. The management system shall be clearly defined to staff and customers through an effective means of communication.

4.1.6. Testing and internal calibrations shall be properly supervised by technically qualified managers that have overall responsibility and authority over technical staff and the work they carry out, and reports that are issued.

4.1.7. A member of the technical staff shall be appointed to manage the quality of the work carried out in the gemmological laboratory. This manager shall ensure that all test protocols are adhered to, that quality systems are followed at all times that the staff is aware of their quality related responsibilities at all times.

4.2. Management systems

4.2.1. A system of protocols that ensure the quality of the work carried out by the gemmological laboratory shall be available to the staff and that the contents are effectively communicated. These protocols shall cover all aspects of the gemmological laboratory functions, including but not limited to, receipting of goods, weights and measures, inventory control, work distribution, instrument maintenance and operation, results analysis and report nomenclature.

4.2.2. All management systems shall be reviewed at least annually and a written quality statement issued by top management. This statement shall commit management to the observation of best practices in the identification and reporting on gem materials and the quality of services given to customers. The statements should also indicate management’s commitment to compliance with the Gemmological Laboratory Book and/or ISO/IEC 17025.

4.3. Document Control
4.3.1. A full list of approved documents and their current status shall be established and shall be readily available to preclude the use of out of date versions. All approved documents shall be available in and to all locations.

4.3.2. All altered or new document text shall be identified in the document or the appropriate attachments.

4.3.3. There shall be clear procedures to describe how changes in documents are made and controlled.

4.3.4. Documents must include the list of related attachments.

4.4. Review of customer requests

4.4.1. Requirements and or requests shall be clearly established upon receiving gem materials from a customer.

4.4.2. All test methods shall be adequately defined and be clearly understood by the gemmological laboratory.

4.4.3. The gemmological laboratory shall have the capability and resources to meet the customer’s requirements and/or requests.

4.4.4. Any differences in understanding between the customer and the gemmological laboratory shall be resolved prior to any work being carried out.

4.4.5. Records shall be kept of any discussions with customers.

4.5. Subcontracting of tests

4.5.1. When a gemmological laboratory subcontracts work, this work shall be placed with a competent subcontractor.

4.5.2. If customer’s work is subcontracted the gemmological laboratory shall advise customers of the circumstances, including the acknowledgement of their continued responsibility for the gem materials submitted.

4.6. Service to the customer

4.6.1. Within the limitations set by security requirements, the gemmological laboratory shall agree to any customer request for the monitoring of performance related to the work performed, provided also that the gemmological laboratory ensures confidentiality to other customers.

4.6.2. The gemmological laboratory shall seek feedback from its customers. This feedback shall be used to improve the management system, testing and internal calibration activities and customer services.

4.7. Complaints
4.7.1. The gemmological laboratory shall have a policy and procedure for the resolution of complaints received from customers or other parties. Records shall be maintained of all complaints and of the investigations and corrective actions taken by the gemmological laboratory.

4.7.2. A secondary customer should make any complaints through the primary customer. Responses to complaints shall be given to the primary customer only.

4.8. Corrective action

4.8.1. The gemmological laboratory shall establish a policy and a procedure and shall designate appropriate authorities for implementing corrective action when departures from the policies and procedures in the management system or technical operations have been identified.

4.9. Additional audits

4.9.1. Where the identification of departures casts doubts on the gemmological laboratory’s compliance with its own policies and procedures, or on its compliance with this CIBJO Gemmological Laboratory Book, the gemmological laboratory shall ensure that the appropriate areas of activity are audited as soon as possible.

4.10. Control of records

4.10.1. The gemmological laboratory shall establish and maintain procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. Quality records shall include reports from internal audits and management reviews as well as records of corrective and preventive actions.

4.11. Internal audits

4.11.1. The gemmological laboratory shall periodically conduct internal audits of its activities to verify that its operations continue to comply with the requirements of the management system and this CIBJO Gemmological Laboratory Book. Such audits shall be carried out by trained and qualified personnel who are, wherever resources permit, independent of the activity to be audited.

4.12. Management reviews

4.12.1. The gemmological laboratory’s top management shall periodically conduct a review of the gemmological laboratory’s management system and testing and/or internal calibration activities to ensure their continuing suitability and effectiveness, and to introduce necessary changes or improvements. The review shall take account of
- the suitability of policies and procedures;
- reports from managerial and supervisory personnel;
- the outcome of recent internal audits;
• corrective and preventive actions;
• assessments by external bodies;
• the results of inter laboratory comparisons or proficiency tests;
• changes in the volume and type of the work;
• customer feedback;
• complaints;
• recommendations for improvement;
• other relevant factors, such as quality control activities, resources and staff training.

A typical period for conducting a management review is once every 12 months. Results should be fed into the laboratory planning system and should include the goals, objectives and action plans for the coming year. A management review includes consideration of related subjects at regular management meetings.

5. Technical requirements

Many factors determine the correctness and reliability of the tests, grading and/or internal calibrations performed by a gemmological laboratory. These factors include contributions from:

• human factors;
• accommodation and environmental conditions;
• test and calibration methods and method validation;
• equipment;
• measurement traceability;
• samples;
  the handling of test and calibration items.

5.1. Personnel

5.1.1. The gemmological laboratory management shall ensure the competence of all who operate specific equipment, perform tests and/or internal calibrations, evaluate results, and sign test reports. When using staff that are undergoing training, appropriate supervision shall be provided. Personnel performing specific tasks shall be qualified on the basis of appropriate education, training, experience and/or demonstrated skills, as required. The gemmological laboratory shall maintain current anonymous job descriptions for managerial, technical and key support personnel involved in tests and/or internal calibrations.

5.1.2. The gemmological laboratory should count on the presence of a minimum of three persons as defined in 5.1.1.

5.2. Accommodation and environmental conditions

5.2.1. Gemmological laboratory facilities for testing and/or grading and internal calibration shall be such as to facilitate correct performance of the tests and/or grading and in line with international agreements. The gemmological
laboratory shall ensure that the environmental conditions do not invalidate the results or adversely affect the required quality of any measurement. The technical requirements for accommodation and environmental conditions that can affect the results of tests and grading shall be documented.

5.3. Equipment

5.3.1. The gemmological laboratory shall be furnished with all items of equipment required for the correct performance of the tests and/or grading and internal calibration. See also CIBJO Application Document for Laboratories (www.cibjo.org). In those cases where the gemmological laboratory needs to use equipment outside its permanent control, it shall ensure that the requirements of this CIBJO Gemmological Laboratory Book are met.

5.3.2. Equipment shall be operated by authorised personnel. Up-to-date instructions on the use and maintenance of equipment shall be readily available for use by the appropriate gemmological laboratory personnel.

5.3.3. Records shall be maintained of each item of equipment and its software significant to the tests, grading and/or internal calibrations performed. The records shall include at least the following:

- date of purchase
- the identity of the item of equipment and its software;
- the manufacturer’s and distributors name, type identification, and serial number or other unique identification;
- checks that equipment complies with the specification;
- the current location, where appropriate;
- the manufacturer’s instructions, if available, or reference to their location;
- dates, results and copies of reports of all calibrations, adjustments, acceptance criteria and the due date of next calibration;
- the maintenance plan, where appropriate, and maintenance carried out to date;
- any damage, malfunction, modification or repair to the equipment.

5.4. Testing and grading

5.4.1. Where traceability of measurements to SI units is not possible and/or not relevant, the same requirements for traceability to, for example, certified reference materials, agreed methods (see under 6.) and/or consensus standards, are required.

5.5. Reference standards and reference materials

5.5.1. The gemmological laboratory shall have a programme and procedure for the calibration of its reference standards. Reference standards shall be calibrated by a body that can provide traceability. Such reference standards held by the gemmological laboratory shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.
5.6. Sampling

5.6.1. The gemmological laboratory shall have a sampling plan and procedures for sampling when batch testing. The sampling plan as well as the sampling procedure shall be available at the location where sampling is undertaken. Sampling plans shall, whenever reasonable, be based on appropriate statistical methods.

5.6.2. Where the customer requires deviations, additions or exclusions from the documented sampling procedure, these shall be recorded in detail with the appropriate sampling data and shall be included in all documents containing test and/or calibration results, and shall be communicated to the appropriate personnel.

5.7. Assuring the quality of test and grading results

5.7.1. The gemmological laboratory shall have quality control procedures for monitoring the validity and results reproducibility of tests, grading and internal calibrations undertaken. The resulting data shall be recorded in such a way that trends are detectable and, where practicable, statistical techniques shall be applied to the reviewing of the results.

5.8. Reporting the results

5.8.1. Each test report shall include at least the following information, unless the gemmological laboratory has valid reasons for not doing so:

- a title (e.g. “Test Report”);
- the name and address of the gemmological laboratory, and the location where the tests were carried out, if different from the address of the gemmological laboratory;
- unique identification of the test report (such as the serial number), and on each page an identification in order to ensure that the page is recognised as a part of the test report, and a clear identification of the end of the test report;
- the name and address of the customer (client optional);
- a description of, the condition of, and unambiguous identification of the item(s) tested;
- the date of receipt of the test item(s) where this is critical to the validity and application of the results, and the date(s) of performance of the test;
- the test or grading results with, where appropriate, the units of measurement;
- opinions and interpretations where appropriate and needed; in many cases it may be appropriate to communicate the opinions and interpretations by direct dialogue with the customer: such dialogue should be written down.
- additional information which may be required by specific methods, customers or groups of customers;
- the name(s), function(s) and signature(s) or equivalent identification of person(s) authorising the test report or the name of the legal entity.
5.8.2. In the case of transmission of test results by telephone, telex, facsimile or other electronic or electromagnetic means, the guidelines of this CIBJO Gemmological Laboratory Book shall be met.

5.8.3. The format of the report shall be designed to accommodate each result obtained and to minimise the possibility of misunderstanding or misuse. The headings should be standardized as far as possible.

5.8.4. The report should have suitable security measures, such as a hologram or embossed seal, to minimise potential for fraud.

5.8.5. Copies of reports, working notes, etc. shall be retained in a secure manner for at least 10 years, or longer if local regulations require.

5.9. Amendments to test reports

5.9.1. Material amendments to a test report after issue shall be made only in the form of a further document, or data transfer, which includes the statement: “Supplement to Test Report, serial number … or an equivalent form of wording. When it is necessary to issue a complete new report, this shall be uniquely identified and shall contain a reference to the original that it replaces.

6. Test method protocol

Required test methods are listed, which shall be applied to correctly identify the gem material stated. The listed test method is mandatory, unless a remark indicates otherwise. Definitions of the test methods are listed under 6.3. and the indicated key references on which the protocol is based, are given under 6.4.

6.1. Test methods gemstones

6.1.1. Actinolite

<table>
<thead>
<tr>
<th>Required Test Method</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microscope</td>
<td></td>
</tr>
<tr>
<td>Phenomena</td>
<td>Cat's-eye</td>
</tr>
<tr>
<td>Refractometer (refractive index)</td>
<td></td>
</tr>
<tr>
<td>Hydrostatic weighing (specific gravity)</td>
<td></td>
</tr>
<tr>
<td>Raman spectroscopy</td>
<td>If other tests are inconclusive</td>
</tr>
<tr>
<td>XRD</td>
<td>If other tests are inconclusive</td>
</tr>
</tbody>
</table>

References

Burns and Greaves (1971); Crowningshield (1969); Fryer (1993a); Hietanen (1971); Ishida et al. (2002); Lucas (1974); Mustard (1992); Pough (1987); Skogby and Annersten (1986); Smelik et al. (1991); Washington and Merwin (1923)

Special attention: dye

6.1.2. Alexandrite
### 6.1.3. Amblygonite

<table>
<thead>
<tr>
<th>Required Test method</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microscope</td>
<td></td>
</tr>
<tr>
<td>Phenomena</td>
<td></td>
</tr>
<tr>
<td>Refractometer (refractive index)</td>
<td>Cat’s-eye, colour-change</td>
</tr>
<tr>
<td>Spectroscope</td>
<td></td>
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<tr>
<td>Hydrostatic weighing (specific gravity)</td>
<td>If other tests are inconclusive</td>
</tr>
<tr>
<td>Raman spectroscopy</td>
<td></td>
</tr>
<tr>
<td>XRD</td>
<td>If other tests are inconclusive</td>
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</table>

**References**


### 6.1.4. Ammonite

<table>
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**References**


Special attention: coating, impregnation

6.1.5. Anatase

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6.1.6. Andalusite

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6.1.7. Apatite

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6.1.8. Aquamarine

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References

Special attention: heat treatment, irradiation (Maxixe), clarity enhancement, coatings, synthetics

6.1.9. Aragonite

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XRD If other tests are inconclusive

References

Special attention: dye

6.1.10. Axinite

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6.1.11. Benitoite

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6.1.12. Beryl (yellow, colourless, pink, red)
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**References**


Special attention: clarity enhancement, synthetics

### 6.1.13. Beryllonite

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**References**


### 6.1.14. Brazilianite

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**References**


### 6.1.15. Calcite

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**References**


Special attention: fragile, dye, coatings

### 6.1.16. Chalcedony

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Microscope               |                      
Refractometer (refractive index) |                      
Hydrostatic weighing (specific gravity) |                      
Chelsea Colour Filter |                      
Spectroscope | Green variety
EDXRF chemistry | Green variety
Raman spectroscopy | If other tests are inconclusive

**References**


Special attention: dye

### 6.1.17. Charoite

**Required Test method** | **Remark**
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Microscope               |                      
Refractometer (refractive index) |                      
Hydrostatic weighing (specific gravity) |                      

**References**


### 6.1.18. Chrysoberyl
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### References


### Special attention: dyed (with Cu)

### 6.1.19. Chrysocolla

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### References


### Special attention: dyed (with Cu)

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### References


### 6.1.21. Danburite

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### References


### 6.1.22. Diamond (colourless) — identification only

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### References

Special attention: irradiation, HP-HT, coatings, clarity enhancement, synthetics for diamond grading, see ISO 24016

### 6.1.23. Diamond (coloured)

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**References**


Special attention: HP-HT, coatings, clarity enhancement, synthetics

### 6.1.24. Diaspore

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6.1.25. **Diopside**

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**References**


6.1.26. **Dioptase**

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**References**


6.1.27. **Dolomite**

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6.1.28. Dumortierite

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References
Alexander et al. (1986), Applin and Hicks (1987), Bank (1979), Beukes et al. (1987), Cassedanne and Franco (1966), Corwningshield (1964), Goreva et al. (2001), Koivula et al. (1992), Ostwald (1964)

Special attention: radioactive

6.1.29. Ekanite

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References

Special attention: radioactive

6.1.30. Emerald

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---|---
Chelsea colour filter | 
Spectroscope | 
Long-wave UV fluorescence | 
UV-Visible(-NIR) spectroscopy | Origin
FTIR(-NIR) spectroscopy | Synthetic/natural and filler ID
EDXRF chemistry | Origin
Raman spectroscopy | Only for filler ID
LA-ICP-MS spectroscopy | If necessary for origin
Colour call | 
Clarity enhancement check/extent

**References**


Special attention: clarity enhancement (also cavity and wide fracture filling), synthetics, coating and dye

6.1.31. **Enstatite**

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| Refractometer (refractive index) | 
| Hydrostatic weighing (specific gravity) | If loose and other tests inconclusive
### 6.1.32. Epidote

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**References**

### 6.1.33. Feldspar – orthoclase, moonstone, microcline, albite, oligoclase, bytownite

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**References**
### 6.1.34. Feldspar – labradorite, andesine

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**References**


*Special attention: heat, Cu-diffusion*

### 6.1.35. Fluorite

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**References**


*Special attention: fragile, easy cleavage*

### 6.1.36. Forsterite

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Short-wave UV fluorescence  
FTIR(-NIR) spectroscopy  
EDXRF chemistry  
Raman spectroscopy

**References**


**Special attention: synthetic**

### 6.1.37. Gahnospinel

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**References**


### 6.1.38. Garnet – Pyrope, Almandine, Spessartine, Grossular (hessonite, tsavorite), Andradite (demantoid), Uvarovite

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**References**

**Special attention: heat treatment (demantoid)**

6.1.39. **Gypsum**

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**References**


**Special attention: soft material, easy cleavage**

6.1.40. **Hauyn**

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**References**


6.1.41. **Hematite**

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**References**


**Special attention: various imitations, non-magnetic and magnetic. It may not be possible to separate from manufactured material.**
### 6.1.42. **Idocrase (Vesuvianite)**

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**References**

### 6.1.43. **Iolite (Cordierite)**

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**References**

### 6.1.44. **Jadeite – green, white, black, lavender**

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**References**
Special attention: other jadeite-like minerals or rocks, omphacite, dye, resin, impregnation, wax, plastic coating

### 6.1.45. Jasper

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**References**


### 6.1.46. Jeremejevite

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**References**


### 6.1.47. Kornerupine

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**References**


6.1.48.  **Kyanite**

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**References**


6.1.49.  **Lapis Lazuli**

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**References**


**Special attention:** dye, coatings, impregnation, wax, ‘synthetics’, imitations

6.1.50.  **Magnesite**

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EDXRF chemistry
Raman spectroscopy
XRD (if other tests are inconclusive)

References

Special attention: crystalline variety very soft, massive variety often used with dye

6.1.51. Malachite

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References
Balitsky and Bublikova (1990), Balitsky et al. (1987a,b), Bank et al. (1998), Bennett (1992),
Goga (2000), Hen and scheider (1994), Hosaka (1990), Kammerling and Fryer (1994), Koivula and
Webster (1958)

Special attention: reconstructed, impregnated, wax, synthetic

6.1.52. Maw-sit-sit

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References

6.1.53. Moldavite

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References

### References


Special attention: artificial glass

### 6.1.54. Nephrite

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References


Special attention: dye

### 6.1.55. Obsidian

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References

Acquafredda et al., 1999; Baugh and Nelson, 1987; Bavay et al., 2000; Bellot-Gurlet et al., 2008; Bellot-Gurlet et al., 2005; Bigazzi et al., 1992; Bigazzi et al., 1986; Biró, 2004; Bunney, 1985; Calligaro, 2008; Cohen, 1958; Craig et al., 2010; Craig et al., 2007; Crowningshield, 1975; Faulques et al., 2001; Glascock, 2002; Henne, 1995; Holzhey, 1996; Hughes, 1982; Hyrsl and Žáček, 1999; Johnson and Koivula, 1997, 1998; Kelloway et al., 2010; Koivula and Fritsch, 1993a, b; Miller, 2006; Milhauser et al., 2011; Moses et al., 1998; O’Keefe, 1984; Pereira et al., 2001; Poupeau et al., 2010; Rosen et al., 2005; Rozsa et al., 2006; Sheppard et al., 2011; Sinkankas, 1996; Spriggs et al., 2011; Webster, 1949; Weiner, 1983; Williams-Thorpe, 1995; Zook, 1973

Special attention: artificial glass

### 6.1.56. Opal

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**Long-wave UV fluorescence**

**Long-wave UV phosphorescence**

**Short-wave UV fluorescence**

**Short-wave UV phosphorescence**

**UV-Visible(-NIR) spectroscopy**

If dye is suspected

**FTIR(-NIR) spectroscopy**

**References**


**Special attention: sugar and smoke treatments, dye, impregnation, synthetics**

### 6.1.57. Pectolite

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**References**


### 6.1.58. Peridot

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Spectroscope

References

Special attention: may be damaged by acids

6.1.59.  Petalite

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References

6.1.60.  Phenakite

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**References**


### 6.1.62. Plastic

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**References**


### 6.1.63. Prehnite

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**References**

Akızuki 1987; Bank 1975a; Beattie and Brown 1985; Bracewell 1989; Brown and Snow 1981;
6.1.64. **Pyrite**

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**References**


*Special attention: marcasite (misnomer), steel imitation*

6.1.65. **Quartz (amethyst, citrine, rock crystal, smoky, rose, aventurine, etc.)**

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**References**

Special attention: synthetics, coatings, irradiation, heat treatment, dyed and impregnated (quartzite)

6.1.66. **Rhodochrosite**

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**References**


Special attention: easy cleavage single crystal material

6.1.67. **Rhodonite**

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**References**

### 6.1.68. Ruby

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### References

Special attention: heat treatment, residues, diffusion, (lead) glass filling, dye, synthetics

6.1.69.  Sapphire

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6.1.70. **Sapphirine**

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**References**


6.1.71. **Saussurite**

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**References**

Jobbins and Rutland 1974; Scarratt 1987c, e

6.1.72. **Scapolite**

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**References**

Jobbins and Rutland 1974; Scarratt 1987c, e

Special attention: heat treatment, diffusion, (lead, cobalt) glass filling, Synthetics
### Microscope Phenomena

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### References


#### 6.1.73. Serpentine – bowenite, williamsite

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### References


### Special attention: dye

#### 6.1.74. Sinhalite

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### References

Anderson 1952a, b, 1974; Bank 1977; Bauernhansl and Beran 1997; Bowden et al. 1969; Claringbull and Hey 1952; Crowningshield 1958, 1960; Deen 1984; Dharmaratne 1998, 1999; Fang and

### 6.1.75. Sillimanite

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**References**


*Special attention: single crystal has easy cleavage*

### 6.1.76. Sodalite

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**References**


*Special attention: dye*

### 6.1.77. Sphene (Titanite)

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6.1.78. Spinel

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References

Special attention: synthetics, heat-treatment
### 6.1.79. Spinel (cobalt)

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**References**


**Special attention:** synthetics

### 6.1.80. Spodumene

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**References**


**Special attention:** easy cleavage, irradiation: blue-green will fade

### 6.1.81. Sugilite

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6.1.82. Taaffeite

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**References**


Special attention: Taaffeite is a synonym of Magnesiaaffeite-2N’2S, Musgravite is a synonym of Magnesiaaffeite-6N’3S.

6.1.83. Tektite

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**References**


6.1.84. Thomsonite

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**References**

6.1.85. **Topaz**

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**References**


**Special attention: characteristic appearance**

6.1.86. **Tourmaline**

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**References**

6.1.87. **Tugtupite**

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**References**


6.1.88. **Turquoise**

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**References**

Special attention: impregnation, dye, composites, imitation matrix, synthetics

6.1.89. **Ulexite**

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<td>Raman spectroscopy</td>
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</tr>
</tbody>
</table>

**References**

Crowningshield 1957; Garlick and Kamb 1991; Ghose 1978; Sinkankas 1955

Special attention: very soft

6.1.90. **Variscite**

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**References**


6.1.91. **Zircon**

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</tr>
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**References**


Special attention: heat treatment

6.1.92. Zoisite

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<td>EDXRF chemistry</td>
<td>Cobalt coating</td>
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References


Special attention: heat treatment, clarity enhancement, coating

6.2. Test methods pearls and organic gem materials

6.2.1. Amber

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<td>Refractometer (refractive index)</td>
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<td>Hydrostatic weighing (specific gravity)</td>
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</tr>
<tr>
<td>FTIR(-NIR) spectroscopy</td>
<td></td>
</tr>
</tbody>
</table>
References


Special attention: clarity enhanced, dyed, heated (with pressure), pressed, reconstructed (encased in plastics), faked insects, recent resins

6.2.2. Bone

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<tr>
<td>Hydrostatic weighing (specific gravity)</td>
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</tr>
</tbody>
</table>

References

Arnould and Poiriot (1975), Brown and Lund (1979), Cognet et al. (2003), Lesh (1980), Mann and Brown (2008), Pewkliang et al. (2008), Scarratt (1992), Webster (1948)

Special attention: dye, impregnation

6.2.3. Copal

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</table>

References

Clery (2002), Winkler et al. (2001)

6.2.4. Coral

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6.2.5. Horn

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<td>Hydrostatic weighing (specific gravity)</td>
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</tr>
<tr>
<td>Raman spectroscopy</td>
<td>If other tests are inconclusive</td>
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</tbody>
</table>

References
Brown (1976), Liddicoat (1970), Webster (1973)

Special attention: dye, imitations

6.2.6. Ivory – elephant, mammoth/mastodon, hippopotamus, walrus, narwhal

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<td>Hydrostatic weighing (specific gravity)</td>
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</tr>
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<td>Long-wave UV fluorescence</td>
<td></td>
</tr>
<tr>
<td>Raman spectroscopy</td>
<td></td>
</tr>
<tr>
<td>X-Ray CT scan</td>
<td>In some cases to view growth structures</td>
</tr>
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References

Special attention: dye, imitations, CITES issues.

6.2.7. Ivory - vegetable
### 6.2.8. Pearl (Abalone Species)

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<td>Raman spectroscopy</td>
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**References**


**Special attention:** blister versus cyst, damage by acids

### 6.2.9. Pearl (Cassis species)

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<tr>
<td>Raman spectroscopy</td>
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</table>

**References**

(Landman et al. (2001), Strack (2006))

**Special attention:** possible similarity with Melo pearls and other orange porcellaneous pearls, damage by acids, shell imitations

### 6.2.10. Pearl (Lobatus gigas/Strombus gigas – Conch)

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<td></td>
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<tr>
<td>Raman spectroscopy</td>
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</table>

**References**

Special attention: X-ray discolouration to pink samples, possible similarity to other porcellaneous pearls when not the usual pink colour (i.e., white, orange to purplish), damage by acids, shell imitations

6.2.11. Pearl (Hyriopsis cummingi and other freshwater mussels)

<table>
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<tr>
<td>EDXRF chemistry</td>
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<tr>
<td>Raman spectroscopy</td>
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</tr>
<tr>
<td>LA-ICP-MS chemistry</td>
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</tr>
<tr>
<td>X-Ray CT scan</td>
<td>Difficult cases</td>
</tr>
</tbody>
</table>

References

Special attention: natural versus non-beaded cultured, blister versus cyst, bleaching, irradiation, dyes, Maeshori treatment, damage by acids.

6.2.12. Pearl (Imitation)

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<tr>
<td>Raman spectroscopy</td>
<td>If other tests are inconclusive</td>
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</tbody>
</table>

References

Special attention: mixed into items with nacreous samples. When applying microradiography, some solid plastic imitations may appear similar to nacreous pearls with a tight structure.

6.2.13. Pearl (Lambis species)

<table>
<thead>
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<tbody>
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<td>UV-Visible(-NIR) spectroscopy</td>
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<tr>
<td>Raman spectroscopy</td>
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</tbody>
</table>

References
Landman et al. (2001), Strack (2006)
Special attention: possible similarity to other brownish or near-white porcelaneous pearls, damage by acids.

6.2.14. **Pearl (Melo species)**

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<tr>
<td>Raman spectroscopy</td>
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</tbody>
</table>

**References**

Landman et al. (2001), Poppe (1992), Scarratt 1992d, 1994b; Sciaguato 2004; Strack (2006); Traub 1997; Traub et al. 1999

Special attention: X-ray discolouration to orange samples, possible similarity to other orange porcelaneous pearls, damage by acids, check for shaped examples, shell imitations

6.2.15. **Pearl (Mercenaria mercenaria)**

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<td>UV-Visible(-NIR) spectroscopy</td>
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<td>Raman spectroscopy</td>
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**References**


Special attention: possible similarity to other purplish or even white non-nacreous pearls, damage by acids.

6.2.16. **Pearl (Mytilus species)**

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<tr>
<td>UV-Visible(-NIR) spectroscopy</td>
<td></td>
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<tr>
<td>Raman spectroscopy</td>
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</tbody>
</table>

**References**


Special attention: possible similarity to other dark hued or purplish nacreous pearls, damage by acids.

6.2.17. **Pearl (Pinctada fucata)**

<table>
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<tbody>
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</tbody>
</table>
### Microradiography

**UV-Visible(-NIR) spectroscopy**  
Off-white pearls only

**EDXRF chemistry**

**Raman spectroscopy**

### References


Special attention: possible similarity to other nacreous pearls, blister versus cyst, coatings, irradiated bead nuclei in bead cultured pearls, damage by acids.

#### 6.2.18. Pearl (*Pinctada margaritifera*)

<table>
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</tr>
<tr>
<td>Raman spectroscopy</td>
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</table>

References


Special attention: possible similarity to other nacreous pearls, blister versus cyst, dye, bleaching (“Chocolate pearls”), coatings, damage by acids.

#### 6.2.19. Pearl (*Pinctada maxima*)

<table>
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<td>Off-white pearls only</td>
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<td>Raman spectroscopy</td>
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<tr>
<td>LA-ICP-MS chemistry</td>
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<tr>
<td>X-Ray CT scan</td>
<td>Difficult cases</td>
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</table>

References


Special attention: natural versus non-beaded cultured, possible similarity to other nacreous pearls, blister versus cyst, dye, bleaching, coatings, Maeshori treatment, damage by acids.
6.2.20. **Pearl (Pinctada mazatlantica)**

<table>
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<td>EDXRF chemistry</td>
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<td>Raman spectroscopy</td>
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</table>

*References*


Special attention: possible similarity to other nacreous pearls, blister versus cyst, dye, bleaching (“Chocolate pearls”), coatings, damage by acids.

6.2.21. **Pearl (Pinctada radiata)**

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<td>Off-white (stronger than light tones) samples only</td>
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<tr>
<td>EDXRF chemistry</td>
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</tr>
<tr>
<td>Raman spectroscopy</td>
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<tr>
<td>X-Ray CT scan</td>
<td>Difficult cases</td>
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*References*


Special attention: natural versus non-beaded cultured, possible similarity to other nacreous pearls, blister versus cyst, dye, bleaching, coatings, damage by acids.

6.2.22. **Pearl (Pinna species [including Atrina species])**

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<td>UV-Visible(-NIR) spectroscopy</td>
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<td>EDXRF chemistry</td>
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<tr>
<td>Raman spectroscopy</td>
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</tbody>
</table>

*References*


Special attention: possible similarity to other dark hued nacreous and non-nacreous pearls, durability of heavily cracked samples, damage by acids.
### 6.2.23. Pearl (Pleuropoca species)

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<td>Microradiography</td>
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<tr>
<td>UV-Visible(-NIR) spectroscopy</td>
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</tr>
<tr>
<td>Raman spectroscopy</td>
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</tbody>
</table>

**References**
- Landman et al. (2001), Strack (2006)

*Special attention: possible similarity to other yellowish to brown porcellaneous pearls, damage by acids*

### 6.2.24. Pearl (Pteria species)

<table>
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<td>UV-Visible(-NIR) spectroscopy</td>
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</tr>
<tr>
<td>EDXRF chemistry</td>
<td></td>
</tr>
<tr>
<td>PL spectroscopy</td>
<td>Helps with mollusc identification in some cases</td>
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<tr>
<td>Raman spectroscopy</td>
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</table>

**References**

*Special attention: natural versus non-beaded cultured, a-typical bead nuclei, possible similarity to other nacreous pearls, blister versus cyst, bleaching, dyes, coatings, damage by acids.*

### 6.2.25. Pearl (Scallop [pectinidae] species)

<table>
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</tr>
<tr>
<td>Raman spectroscopy</td>
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</tbody>
</table>

**References**

*Special attention: possible similarity to other white to lightly coloured non-nacreous/porcellaneous pearls, damage by acids.*

### 6.2.26. Pearl (Tridacna [clam] species)

<table>
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<tr>
<td>Microradiography</td>
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</tbody>
</table>
UV-Visible(-NIR) spectroscopy
Raman spectroscopy

**References**

Hardy (1947), Landman et al. (2001), Strack (2006)

*Special attention: possible similarity to other white to lightly coloured porcellaneous pearls, shell imitations, CITES, damage by acids*

### 6.2.27. Shell

<table>
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<td>Hydrostatic weighing (specific gravity)</td>
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**References**


*Special attention: dye, lustre enhancement*

### 6.2.28. Tortoise shell

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<td>Hydrostatic weighing (specific gravity)</td>
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<td>Short-wave UV phosphorescence</td>
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</tbody>
</table>

**References**

Brown 1978, 1995b; Brown and Lund 1979; Hainschwang and Leggio 2006; Scarratt 1992a

*Special attention: structure, protein smell (hot point), plastic (common imitation)*

### 6.3. Test methods definitions

#### 6.3.1. Clarity enhancement check/extent

Detection of filling of fissures and/or wide fractures and cavities with oils, resins, or any other filler, and an estimation of the extent of this treatment (e.g., none/insignificant, minor, moderate, or significant).

#### 6.3.2. Colour call
Precise colour description is required, for instance to make sure a colour-change is present, or to establish whether a sapphire may be called Padparadscha.

6.3.3. Chelsea colour filter

A filter that only transmits deep red and yellow-green light.

6.3.4. DiamondView

The DiamondView instrument illuminates a diamond with intense short-wave ultra-violet radiation and detects the surface fluorescence that is caused. Fluorescence and Phosphorescence images, showing clear growth patterns, are projected on a computer screen.

6.3.5. Dichroscope

An instrument that allows to detect whether a gemstone shows pleochroism and, if it does, to observe the pleochroic colours side by side, for easy comparison and description.

6.3.6. EDXRF chemistry

Energy-dispersive X-ray fluorescence is a technique whereby a sample is targeted by a high-energy X-ray beam, causing its chemical elements to fluoresce with a spectrum of lower-energy X-rays, each peak being characteristic of a chemical element. The relative concentrations of elements are indicated by the fluorescent X-ray peak intensities.

6.3.7. FTIR(-NIR) spectroscopy

Accurate measurement of absorption or transmission positions, and their relative intensities in the (near-)infrared range of the electromagnetic spectrum. The resulting spectra are measured and digitally recorded by a Fourier Transform Infrared spectrometer. “Fourier Transform” is a mathematical technique used to convert the spectrometer signal into a spectrum plotted as a function of energy. The measurements can be done in different modes, such as e.g., transmission, diffusion reflectance, or by using KBr pellets.

6.3.8. Hydrostatic weighing

The method used to measure the specific gravity (SG) of a gemstone. It is based on the principle of Archimedes, comparing the weight of an object in air (A) with the weight of that object in water (W). The SG can then be calculated:

\[ SG = A/(A-W) \]

6.3.9. Immersion

A gemstone is immersed in a liquid with a similar refractive index to observe features that are otherwise not or less visible, for instance colour distribution or zoning.

6.3.10. LA-ICP-MS Chemistry
Laser Ablation Inductively Coupled Plasma Mass Spectrometry is an analytical technology that enables highly sensitive elemental and isotopic analysis to be performed directly on solid samples. LA-ICP-MS begins with a laser beam focused on the sample surface to generate fine particles – a process known as Laser Ablation. The ablated particles are then transported to the secondary excitation source of the ICP-MS instrument for digestion and ionisation of the sampled mass. The excited ions in the plasma torch are subsequently introduced to a mass spectrometer detector for both elemental and isotopic analysis. It is not entirely non-destructive, but can perform ultra-highly sensitive chemical analysis down to ppb (parts per billion) level.

6.3.11. Microradiography

The process of taking a photograph of an object by using X-rays, showing minute internal structure.

6.3.12. Microscope

A gemmological microscope is a stereo binocular microscope with good depth of vision and field of view, with generally magnification varying in between 10x and 80x. Research microscopes with much higher magnification power may be used as well in gemmological laboratories.

6.3.13. Phenomena

Detection of phenomena, such as colour-change of a gemstone, when viewed in different light conditions, play of colour, labradorescence, reflection of light by inclusions causing chatoyancy (Cat’s-eye), asterism (Star), aventurescence, adularescence; inclusion patterns causing the trapiche effect, bloodshot effect.

6.3.14. PL spectroscopy

Detection of photoluminescence (light emission) of an object illuminated by a laser. Light emission occurs after the excitation by photons (electromagnetic radiation). Different lasers may be used, for example red (633 nm), green (514 and 532 nm), blue (488 nm) and UV (250 nm) lasers. For diamonds, PL is usually performed at low temperature (-196°C)

6.3.15. Pleochroism

A property of doubly refractive coloured gemstones of absorbing light to an extent that depends on the vibration direction of the polarised light rays. The effect causes two different colours (dichroism) or three different colours (trichroism), depending on the type of gemstone. These different colours may be seen when viewing a gemstone from different directions under transmitted light.

6.3.16. Polariscope

A polariscope is an instrument with two polarising filters fitted one above the other in a fixed crossed position, meaning that the transmitted vibration direction of polarisation of the upper filter is at right angles to that of the lower filter. The filters are either fixed on an inbuilt light or placed on a separate light source.
6.3.17. **Raman spectroscopy**

Detection of an extremely slight shift of energy of the light or radiation scattered on the surface of an object illuminated by a laser. The resulting re-emitted spectrum, or Raman spectrum, is characteristic for different (solid or fluid) substances, and allows rapid identification, also if they are enclosed within another transparent substance. Different lasers may be used, for example near-infrared (780 nm), red (633 nm), green (514 and 532 nm), blue (488 nm) and UV (250 nm) lasers.

6.3.18. **Refractometer**

The gemmological refractometer is designed to measure the refractive index or indices of a gemstone. It makes use of total internal reflection of monochromatic light, going through an in-built special type of glass, which is in contact with a flat, polished surface of a gemstone.

6.3.19. **Refractive index**

A simple relationship between the light’s angle of incidence and angle of refraction (the amount of bending), when it reaches and enters a gemstone. The slower the light’s speed in a material, the greater the bending effect, thus the higher the refractive index. Depending on the structure of the material, light will remain as a single ray or be split into two rays; the effects are called “single refraction” (giving one refractive index), and “double refraction” (giving two refractive indices, with a minimum and maximum value).

6.3.20. **Residue check/ extent**

Detection of residue in healed fissures and/or filled cavities as a result of heat-treatment, and an estimation of the extent of this treatment (e.g., none/ insignificant, minor, moderate, or significant).

6.3.21. **Spectroscope**

A spectroscope is essentially a tube with a narrow slit at one end and a lens at the other, with in between an arrangement of optically connected prisms, or a diffraction grating, creating a spectrum - spectral colours of white light that enters the slit and are spread out by the prisms or grating and can be viewed through the lens.

6.3.22. **Long-wave UV fluorescence**

Emission of visible light by a substance when excited by long-wave ultraviolet radiation (principal wavelength of 365 nm), produced by a UV-lamp.

6.3.23. **Long-wave UV phosphorescence**

Continued emission of visible light by a substance after excited by long-wave ultraviolet radiation (principal wavelength of 365 nm), produced by a UV-lamp.

6.3.24. **SEM-EDS**

Scanning Electron Microscopy with Energy Dispersive X-Ray microanalysis is a technique, using an electron beam to scan the surface of an object. Scattered electron
reflections are detected at very high magnification which are displayed as black-and-white images on a screen. Elemental analysis and mapping can be obtained, as the electrons also cause the object’s chemical elements to emit a spectrum of X-rays, each peak being characteristic of a chemical element.

6.3.25. Short-wave UV fluorescence

Emission of visible light by a substance when excited by short-wave ultraviolet radiation (principal wavelength of 254 nm), produced by a UV-lamp.

6.3.26. Short-wave UV phosphorescence

Continued emission of visible light by a substance after excited by long-wave ultraviolet radiation (principal wavelength of 365 nm), produced by a UV-lamp.

6.3.27. Specific Gravity

The ratio of the weight of a substance to the weight of an equal volume of water.

6.3.28. UV-Visible(-NIR) spectroscopy

Accurate measurement of absorption or transmission positions, and their relative intensities in the UV, Visible light (and near-infrared) range of the electromagnetic spectrum. The resulting spectra are measured and digitally recorded by a UV-Visible(-NIR) spectrometer.

6.3.29. X-Ray CT scan

X-Ray computed tomography makes use of computer-processed combinations of many X-ray images taken from different angles around a single axis of rotation, to produces cross-sectional (tomographic) images (virtual “slices”) of specific areas of a scanned object, allowing the user to see inside the object without cutting. Digital geometry processing is used to generate a three-dimensional image of the inside of the object.

6.3.30. XRD

X-Ray Diffraction is a scattering of X-rays by the atoms of a crystal that produces an interference effect so that the diffraction pattern gives information on the structure of the crystal or the identity of a crystalline substance. One of two primary types of XRD analysis (X-ray powder diffraction and single-crystal XRD) is commonly applied.

6.4. Test methods references


Abs-Wurmbach, I., K. Langer and E. Tillmanns (1977), Structure and polarized absorption spectra of Mn3+-substituted andalusites (viridines), *Naturwissenschaften*, 64, 10, 527-528.


Alder, H. H. and Kerr, P. F. (1962) Infrared study of aragonite and calcite, American Mineralogist, 47. 5/6. 700-717


Alexandrowicz, S. and Kwiecinska, B. (1977) Amber from the upper Cretaceous deposits of SW Poland, Mineralogica Polonica, 8. 2. 39-45


Allen, R. D. (1952) Variations in chemical and physical properties of fluorite, American Mineralogist, 30. 1. 1-18


Anderson, B. W. (1946) Distinction between pyrope garnet and red spinel, Gems and Gemology, 5. 5. 301-302 and 304


Anderson, B. W. (1950) Gemstones and the spectroscope - the absorption spectra of emerald and alexandrite, Gems and Gemology, 6. 9. 263-266
distribution in some synthetic (Mg,Zn)(Al,Fe²⁺)₂O₃ spinels. *European Journal of Mineralogy*, 13, (2), 391-402.
Andreozzi, G. B., Lucchesi, S. and Graziani, G. (2000a) Structural study of magnesioaxinite and its crystal-
chemical relations with axinite-group minerals, *European Journal of Mineralogy*, 12. 6. 1185-1194
oxide single crystals, *Hughes Research Laboratories*,
occurring, hydrothermally formed diopside and jadeite, *Physics and Chemistry of Minerals*, 34. 8. 543-549
Angelini, I. and Bellintanti, P. (2005) Archaeological ambers from Northern Italy: An FTIR-drift study of
provenance by comparison with the geological amber database, *Archaeometry*, 47. 2. 441-454
Angino, E. E. (1964) Some effects of pressure on the thermoluminescence of amblygonite, pectolite,
Annamoe, B.B. and Alpatov, V.V. (2001) Morphology of pyrite crystals as an indicator of evolution of mineral
formation environment. *Crystallagenesis and Mineralogy*, 11-12
York 14650.
178-179
40, (5), 1395-1401.
Antao S.M. and Hassan I. (2008a) Increase in Al-Si and Na-Ca disorder with temperature in scapolite Me³².⁹.
*Canadian Mineralogist*, 46, (6), 1577-1591.
Antao S.M. and Hassan I. (2008b) Unusual Al-Si ordering in calcic scapolite, Me⁷⁹.⁶, with increasing
Antao S.M. and Hassan I. (2011a) Complete Al-Si order in scapolite Me³⁷.⁵, ideally
Ca₃Na[(Al₅Si₉O₄₆)²Cl(CO₃)₃, and implications for antiphase domain boundaries (APBs). *Canadian
Austen, R. L. (1941) Ceylon andalusite, 237
possible reference material? First EMPA, SIMS and SREF data.


Arriens, J. (1973) Idocrase (vesuvianite) - a 250-year puzzle, Mineralogical Record, 4, 164-174

Arem, J. E. (1973) Idocrase (vesuvianite) - a 250-year puzzle, Mineralogical Record, 4, 164-174


Bank, H. and Henn, U. (1990a) Physical and chemical data of gem aquamarines from Nigeria, Canadian Gemmologist, 11. 1. 8-10
Bank, H. and Henn, U. (1990b) Further examinations on synthetic emerald overgrowth on colourless beryl seeds from Lechleitner, Canadian Gemmologist, 11. 2. 39-41
Bank, H., Lenzen, G. and Henn, U. (1989a) Laboratory notes, Zeitschrift der Deutschen Gemmologischen Gesellschaft, 1. 1-4
Bank, H., Lenzen, G. and Henn, U. (1989b) Laboratory notes, Zeitschrift der Deutschen Gemmologischen Gesellschaft, 2. 1-4
Bank, H., Lenzen, G. and Henn, U. (1989c) Laboratory notes, Zeitschrift der Deutschen Gemmologischen Gesellschaft, 3. 1-4
Barber, D. J. and Wenk, H. R. (1979) Deformation twinning in calcite, dolomite, and other rhombohedral carbonated, Physics and Chemistry of Minerals, 5. 2. 141-165
Bariand, P. (1986) La mine du Beix (Puy-de-Dome), Monde et Mineraux, 75. 16-17.
Barth, T. F. W. (1931) Permanent changes in the optical orientation of feldspars exposed to heat, Norsk Geologisk Tidsskrift, 12. 57-72.
Barth, T. F. W. (1932) The chemical composition of noselite and haüyne, American Mineralogist, 17. 10. 466-471.
Barth, T. F. W. (1965b) Relations between optical orientation and structural state in the system of potassium feldspar, Indian Mineralogist, 6. 1/2. 40-47.


Bastos, F. M. (1964) A 15.4-pound Brazilian aquamarine, *Gems and Gemology*, 11, 8. 239-241


Benson, L.B. (1961) Developments and highlights at the Gem Trade Lab in Los Angeles, Gems and Gemology, 10. 5. 143-147
Benstock, E. J., Buseck, P. R. and Steele, I. M. (1997) Cathodoluminescence of meteoritic and synthetic forsterite at 296 and 77K using TEM, American Mineralogist, 82. 3/4. 310-315
Berman, H. and Gonyer, F. A. (1930) Pegmatite minerals of Poland, Maine, American Mineralogist, 15. 8. 375-387
Berman, R. (1957) Some physical properties of naturally irradiated fluorite, American Mineralogist, 42. 3/4. 191-203


Bill, H., Sierro, J. and Lacroix, R. (1967) Origin of coloration in some fluorites, American Mineralogist, 52. 7/8. 1003-1008


Bischoff, J. L. (1969) Temperature controls on aragonite-calcite transformation in aqueous solution, American Mineralogist, 54. 1/2. 149-155

Bischoff, W. D., Bishop, F. C. and Mackenzie, F. T. (1983) Biogenically produced magnesian calcite: inhomogeneities in chemical and physical properties; comparison with synthetic phases, American Mineralogist, 68. 11/12. 1183-1188

Bishop, H. R. (1906), Investigations and Studies in Jade, New York, The Bishop Collection,


Bosshart, G. (1990a) Les emeraudes de Colombie, Revue de Gemmologie a.f.g., 105. 13-16

Bosshart, G. (1990b) Smaragde aus Kolumbien, Deutsche Goldschmiede Zeitung, 4,6,8. 184-186, 96-102, 68-70


Bouska, V. and Rost, R. (1972) Double moldavites in southern Bohemia, Science, 177. 4084. 519-520


Bracewell, H. and Brown, G. (1984) Turquoise or chrysocolla from the Jervois Area, Northern Territory, Australian Gemmologist, 15. 6. 189-195

Bracewell, H. and Brown, G. (1985) Amazonite from the Koppio District - South Australia, Australian Gemmologist, 15. 11. 404-408


Breuer, K. H., Eysel, W. and Muller, R. (1989) Structural and chemical varieties of diopside, Cu_{6}[Si_{6}O_{18}]·6H_{2}O. II. Structural properties, *Zeitschrift fur Kristallographie*, 187. 1. 15-23


Brígida C., Poli S. and Valle M. (2007) High temperature phase relations and topological constraints in the quaternary system MgO-Al_{2}O_{3}-SiO_{2}-Cr_{2}O_{3}: An experimental study. *American Mineralogist*, 92, (5/6), 735-747.


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Calas, G. (1972b) On the blue colour of natural banded fluorites, Mineralogical Magazine, 38, 300. 977-979

Calas, G. (1972a) On the blue colour of natural banded fluorites, Australian Gemmologist, 17, 2. 52-57


Campbell, I. C. C. (1991) A report on one of a number of emeralds from Madagascar, South African Gemmologist, 5, 1, 8-15


Carrà, M. (1970), Ivories of the West, London, Hamlyn, 159 pp., 6003448024,


Cassedanne, J. (1984a) Le chrysoberyl au Brésil, *Revue de Gemmologie a.f.g.*, 80, 7-14
Cassedanne, J. (1985) Andalousite et escapolite de Espirito Santo (Bézil), *Revue de Gemmologie a.f.g.*, 82, 21-25
Cassedanne, J. P. (1982b) Les agates de type Umbu, *Revue de Gemmologie a.f.g.*, 73, 5-8


Clements, T. (1941) The emerald mines of Muzo, Colombia, *South America, Gems and Gemology*, 3, 9, 130-134


Crowningshield, G. R. (1957) New or unusual gem materials encountered in the Institute's Gem Trade Laboratories, Gems and Gemology, 9, 2. 35-37, 61-62
Crowningshield, G. R. (1958b) Synthetic emerald testing, Gems and Gemology, 9, 8. 228
Crowningshield, G. R. (1959a) Andalusite, Gems and Gemology, 9, 10. 292
Crowningshield, G. R. (1959b) Highlights at the Gem Trade Lab in New York, Gems and Gemology, 9, 10. 291-294
Crowningshield, G. R. (1959d) Unusual gemstones, Gems and Gemology, 9, 12. 359-360
Crowningshield, G. R. (1960a) Andalusite, Gems and Gemology, 10. 4. 121
Crowningshield, G. R. (1960b) Black coral, Gems and Gemology, 10. 3. 72-74
Crowningshield, G. R. (1960c) Developments and highlights at the Gem Trade Lab in New York, Gems and Gemology, 10. 3. 67-74, 92
Crowningshield, G. R. (1960d) Developments and highlights at the Gem Trade Lab in New York, Gems and Gemology, 10. 4. 114-123
Crowningshield, G. R. (1960e) Hessonite garnet, Gems and Gemology, 10. 3. 72
Crowningshield, G. R. (1960f) Idocrase cameo, Gems and Gemology, 10. 4. 121
Crowningshield, G. R. (1960g) Pink danburite, Gems and Gemology, 10. 3. 71
Crowningshield, G. R. (1960h) Unusual gemstones, Gems and Gemology, 10. 1. 10, 31
Crowningshield, G. R. (1960i) Unusual stones, Gems and Gemology, 10. 2. 61-62
Crowningshield, G. R. (1961b) Andalusite, Gems and Gemology, 10. 6. 185-186
Crowningshield, G. R. (1961c) Brazilian pegmatite emerald, Gems and Gemology, 10. 8. 244
Crowningshield, G. R. (1961e) Developments and highlights at the Gem Trade Lab in New York, Gems and Gemology, 10. 6. 180-186, 191
Crowningshield, G. R. (1961f) Developments and highlights at the Gem Trade Lab in New York, Gems and Gemology, 10. 8. 242-246
Crowningshield, G. R. (1961i) Rare minerals, Gems and Gemology, 10. 6. 186
Crowningshield, G. R. (1961j) "Yunnan jade", Gems and Gemology, 10. 8. 242
Crowningshield, G. R. (1962a) 3-phase inclusions in fluorite, Gems and Gemology, 10. 12. 376
Crowningshield, G. R. (1962b) Developments and highlights at the Gem Trade Lab in New York, Gems and Gemology, 10. 9. 281-283
Crowningshield, G. R. (1962c) Developments and highlights at the Gem Trade Lab in New York, Gems and Gemology, 10. 12. 376-383
Crowningshield, G. R. (1962e) Rare blue jadeite, Gems and Gemology, 10. 9. 283
Crowningshield, G. R. (1962h) Unusual gem materials, Gems and Gemology, 10. 10. 307
Crowningshield, G. R. (1962i) Unusual stones, Gems and Gemology, 10. 11. 339
Crowningshield, G. R. (1962j) Yellow-orthoclase spectrum, Gems and Gemology, 10. 12. 381-382
Crowningshield, G. R. (1963a) Alexandrite cat's-eye, Gems and Gemology, 11. 4. 104
Crowningshield, G. R. (1963b) Developments and highlights at the Gem Trade Lab in New York, Gems and Gemology, 11. 2. 38-44
Crowningshield, G. R. (1963d) Developments and highlights at the Gem Trade Lab in New York, Gems and Gemology, 11. 3. 80-87
Crowningshield, G. R. (1963f) Rare cat's-eyes, Gems and Gemology, 11. 4. 104
Crowningshield, G. R. (1963g) Orthoclase cat's-eye, Gems and Gemology, 11. 1. 23
Crowningshield, G. R. (1963h) Star almandite, Gems and Gemology, 11. 2. 40
Crowningshield, G. R. (1963i) Unusual gemstones, Gems and Gemology, 11. 3. 86
Crowningshield, G. R. (1963k) Faded dyed jadeite, Gems and Gemology, 11. 4. 100-101
Crowningshield, G. R. (1963l) Treated amazonite, Gems and Gemology, 11. 4. 102
Crowningshield, G. R. (1963m) Yellow cat's-eye apatite, Gems and Gemology, 11. 2. 44
Crowningshield, G. R. (1963n) Lavender-dyed jadeite, Gems and Gemology, 11. 3. 82
Crowningshield, G. R. (1964a) Bytownite, Gems and Gemology, 11. 6. 181
Crowningshield, G. R. (1964b) Developments and highlights at the Gem Trade Lab in New York, Gems and Gemology, 11. 6. 180-184


Crowningshield, G. R. (1964m) Symerald, *Gems and Gemology*, 11. 7. 218


Crowningshield, G. R. (1969a) "Chrome chrysoprase", Gems and Gemology, 13. 4. 121-122
Crowningshield, G. R. (1969b) Chrome-green grossularite, Gems and Gemology, 13. 3. 92-93
Crowningshield, G. R. (1969d) Emerald-green grossularite, Gems and Gemology, 13. 2. 58
Crowningshield, G. R. (1969f) Hydrogrossular, Gems and Gemology, 13. 2. 60
Crowningshield, G. R. (1969g) Jadelike idocrase, Gems and Gemology, 13. 4. 119
Crowningshield, G. R. (1969h) Rare, transparent actinolite, Gems and Gemology, 13. 3. 89
Crowningshield, G. R. (1970a) Alexandrite-like garnet, Gems and Gemology, 13. 5. 162
Crowningshield, G. R. (1970b) A rare alexandrite garnet from Tanzania, Gems and Gemology, 13. 6. 174-177
Crowningshield, G. R. (1970c) Chrome aventurine, Gems and Gemology, 13. 5. 158
Crowningshield, G. R. (1970d) Developments and highlights at GIA's Lab in New York, Gems and Gemology, 13. 5. 156-164
Crowningshield, G. R. (1970e) Developments and highlights at GIA's Lab in New York, Gems and Gemology, 13. 6. 192-201
Crowningshield, G. R. (1970f) Developments and highlights at GIA's Lab in New York, Gems and Gemology, 13. 7. 221-229
Crowningshield, G. R. (1970k) Transparent colorless grossularite, Gems and Gemology, 13. 7. 227-228
Crowningshield, G. R. (1970l) Transparent lazulite and green andalusite, Gems and Gemology, 13. 7. 221-222
Crowningshield, G. R. (1970m) Trapiche emerald, Gems and Gemology, 13. 6. 195
Crowningshield, G. R. (1970o) Zerfass synthetic emerald, Gems and Gemology, 13. 5. 162
Crowningshield, G. R. (1971c) Natural emerald - yes or no!, Gems and Gemology, 13. 12. 379-380
Crowningshield, G. R. (1972a) Apatite cat's-eye, Gems and Gemology, 14. 4. 114
Crowningshield, G. R. (1972b) Dark-blue aquamarine, Gems and Gemology, 14. 4. 111-112
Crowningshield, G. R. (1972d) Paraffin...its pros and cons, Gems and Gemology, 14. 3. 84-85
Crowningshield, G. R. (1972e) Nonfluorescent-synthetic emerald, Gems and Gemology, 14. 1. 10-11
Crowningshield, G. R. (1972f) Recent emerald find, Gems and Gemology, 14. 2. 52-53
Crowningshield, G. R. (1973b) Fire agate, Gems and Gemology, 14. 6. 177
Crowningshield, G. R. (1974c) Developments and highlights at GIA's Lab in New York, Gems and Gemology, 14. 10. 298-305
Crowningshield, G. R. (1974d) Emerald imitations, Gems and Gemology, 14, 10, 300-303
Crowningshield, G. R. (1974f) Other rarities, Gems and Gemology, 14, 10, 299
Crowningshield, G. R. (1974i) Unusual jades identified, Gems and Gemology, 14, 10, 303
Crowningshield, G. R. (1975) Selective dyeing of calcite, Gems and Gemology, 15, 1, 12
Crowningshield, G. R. (1975a) Black is popular, Gems and Gemology, 15, 3, 90-91
Crowningshield, G. R. (1975c) Kornerupine, Gems and Gemology, 15, 3, 92-93
Crowningshield, G. R. (1975d) Developments and highlights at GIA’s Lab in New York, Gems and Gemology, 15, 3, 89-94
Crowningshield, G. R. (1977) Amber from the Dominican Republic, Gems and Gemology, 15, 12, 367-368
Crowningshield, G. R. (1979a) Alexandrite oddities, Gems and Gemology, 16, 5, 148
Crowningshield, G. R. (1979c) Some new imitations, Gems and Gemology, 16, 7, 200
Crowningshield, G. R. (1980a) Blue-green beryl + emerald, Gems and Gemology, 16, 9, 321-322
Crowningshield, G. R. (1980b) A giant chrysoberyl crystal, Gems and Gemology, 16, 9, 320
Crowningshield, G. R. (1980c) Red cat’s-eye chrysoberyl, Gems and Gemology, 16, 9, 322
Cuadra, C. (1994) Polymer clay simulations ivory and turquoise, Ornament, 17, 3, 84-89
Cummings, W. (1983) Ferroaxinite from Bridgeville, New Jersey, Mineralogical Record, 14, 1, 43-44
Currie, S. J. A. (1994) Notes on alexandrite chrysoberyl, Australian Gemmologist, 18, 10, 326-328
Dal Negro, A. and Ungaretti, L. (1971) Refinement of the crystal structure of aragonite, American Mineralogist, 56, 5/6, 768-772
De Weerdt, F. and Van Royen, J. (2000a) HPHT treated diamonds, annealing of type Ia diamond, Antwerp Facets, 34. 36-37


De Weerdt, F. and Van Royen, J. (2000a) HPHT treated diamonds, Antwerp Facets, 34. 36-37
Deen, M. N. (1984) Rare gemstones of Sri Lanka, Lapidary Journal, 38, 1, 238-240
Demenge, J. D. (1994) Utilisation des Roches Ornementales en Gemmologie, University of Nantes - Diploma, 1-75
Demenge, J. D. (1994) Utilisation des Roches Ornementales en Gemmologie, University of Nantes - Diploma, 1-75


Dillon, S. (1981a) Afghanistan situation, Gems and Gemology, 17. 1. 56


Dillon, S. (1981c) Emerald, Gems and Gemology, 17. 2. 117


Dowty E. (1976), Crystal structure and crystal growth: I. The influence of internal structure on morphology - part 1 and 2, American Mineralogist, 61, 5/6, 448-459 and 460-469.


Du Toit, G. (1996a) Alexandrite, JewelSiam, February/March. 76-79

Du Toit, G. (1996b) Moldavite, JewelSiam, December/January. 80-81


Dunn, P. J. (1977) Apatite, Mineralogical Record, 8, 2. 78-79

Dunn, P. J. (1978) Gem peridot and enstatite with spinel inclusions from Chihuahua, Mexico, Journal of Gemmology, 16, 4. 236-238


Durben, D. J., McMillan, P. F. and Wolf, G. H. (1993) Raman study of the high-pressure behavior of forsterite (Mg2SiO4) crystal and glass, American Mineralogist, 78, 11/12. 1143-1148


Engineering and Mining Journal (1890) The sapphires of Kashmir.


Eppl er, W. F. (1960a) A Brazilian emerald (a contribution to the study of crystal growth), *Journal of Gemmology*, 7, 6. 221-225


Farn, A. E. (1973) Blue beryls which are not aquamarines, Journal of Gemmology, 13, 8, 293-295
Faye, G. H. and Harris, D. C. (1969) On the origin of colour and pleochroism in andalusite from Brazil, Canadian Mineralogist, 10, 1, 47-56
Federman, D. (1992) Diffusion treatment can blue the whitest of sapphires but since the color is only skin deep, full disclosure is a duty--one some sellers shirk. Modern Jewelry, 76, 118.


Fenn, P. M. (1977) The nucleation and growth of alkali feldspars from hydrous melts, Canadian Mineralogist, 15, 2, 135-161


Fritsch, E. (1993a) Best way to identify bleached and resin impregnated jadeite, Jewellery News Asia, 86-90.

Fritsch, E. (1993b) GIA says AGIL's findings insufficient, Jewellery News Asia, 86, 90.


Fryer, C. (1984m) Lechleitner synthetic overgrowth, Gems and Gemology, 17. 2. 103
Fryer, C. (1984i) Hematite, magnetic, Gems and Gemology, 17. 1. 43-44
Fryer, C. (1984g) Emerald, oiled, Gems and Gemology, 17. 1. 46-47
Fryer, C. (1984e) Dyed and wax-treated lapis lazuli, Gems and Gemology, 17. 2. 103
Fryer, C. (1984d) Diaspore, a rare gem material, Gems and Gemology, 19. 3. 172-173
Fryer, C. (1984h) Ivory, Gems and Gemology, 17. 3. 162
Fryer, C. (1984g) Emerald substitute, dyed beryl, Gems and Gemology, 20. 3. 167-168
Fryer, C. (1986a) "Coast-blue" spinel, an update, *Gems and Gemology*, 22. 2. 111-113
Fryer, C. (1988b) Biron synthetic emerald, *Gems and Gemology*, 24. 2. 113
Fryer, C. (1993d) Devitrified glass, resembling actinolite, *Gems and Gemology*, 24. 2. 113

Fryer, C. (1996b) Imitation jade. Gems and Gemology, 32. 2. 123


Gasparik, T. (1990) A thermodynamic model for the enstatite-diopside join, American Mineralogist, 75. 9/10. 1080-1091
Gasparik, T. and Litvin, Y. A. (1997) Stability of Na$_2$Mg$_2$Si$_2$O$_7$ and melting relations on the forsterite-jadeite join at pressures up to 22 GPa, European Journal of Mineralogy, 9. 2. 311-326
Gauthier, J. P., Caseiro, J. and Lasnier, B. (1994) Les perles rouges de Pinna nobilis, Revue de Gemmologie a.f.g., 118. 2-4
Gem Trade Lab Notes: Pearls, cultured, with dolomite beads, (1998) Gems and Gemology, 34. 2. 130-131
Ghose, S.W., C.; Clark, J.R. (1978) Ulexite, NaCaB$_5$O$_6$(OH)$_6$·5H$_2$O: structure refinement, polyanion configuration, hydrogen bonding and fiber optics American Mineralogist 63 160-171.
Gillet, P. (1993) Stability of magnesite (MgCO$_3$) at mantle pressure and temperature conditions: A Raman spectroscopic study, American Mineralogist, 78. 11/12. 1328-1331


Graindorge, J. M. (1974) A gemmological study of emerald from Poona, Western Australia, Australian Gemmologist, 12. 3. 75-80
Gravender, M. D. (1935) Chrysoberyl (alexandrite, cat's-eye and chrysolite), Gems and Gemology, 1. 1. 9-10
Greiner, D. J. and Bloss, F. D. (1987) Amblygonite-montebasite optics: Response to (OHO-) orientation and rapid estimation of F from 2V, American Mineralogist, 72, 5/6. 617-624
Griesbach, C. L. (1892) The geology of Safed Koh, Geological Survey of India - Records, 25. 2. 71


Gübelin, E. J. (1945) Inclusions as a means of identification - Parts 1, 2 and 3, Gems and Gemology, 5. 2, 3, 4, 226-231, 242-247, 270-274
Gübelin, E. J. (1950) Some additional data on Indian emeralds, Gems and Gemology, 7. 1. 13-22
Gübelin, E. J. (1955) Amblygonite: Old mineral - new gem, Gems and Gemology, 8. 7. 208-214
Gübelin, E. J. (1956a) The emerald from Habachtal, Gems and Gemology, 8. 10. 295–309
Gübelin, E. J. (1959) Promenores sôbre as novas esmeraldas de Sandawana, Revista Gemologia, 5. 17. 1–10
Gübelin, E. J. (1960) More light on beryls and rubies with synthetic overgrowth, Gems and Gemology, 10. 4. 105-113
Gübelin, E. J. (1961a) Ekanite: Another new metamict gem from Ceylon, Gems and Gemology, 10. 6. 163–179, 191
Gübelin, E. J. (1961b) Hydrothermal rubies and emerald-coated beryl, Journal of Gemmology, 8. 2. 49-63
Gübelin, E. J. (1962c) Ekanite, Gemmologist, 31. 373, 374. 142-152, 165-196
Gübelin, E. J. (1964) Ekanit: Ein neuer metamikter Edelstein aus Ceylon, Gold und Silber,
Gübelin, E. J. (1964a) Two new synthetic emeralds, Gems and Gemology, 11. 5. 139–148
Gübelin, E. J. (1964b) Zwei neue synthetische Smaragde, Zeitschrift der Deutschen Gesellschaft für Edelsteinkunde, 47.
Gübelin, E. J. (1968) Gemmologische Beobachtungen am neuen Smaragd aus Pakistan, Der Aufschluss, Special Issue 18.
Gübelin, E. J. (1976a) Alexandrite from Lake Manyara, Tanzania, Gems and Gemology, 15. 7. 203–209
Gübelin, E. J. (1976c) Problem des farbwechsels im alexandrit, Zeitschrift der Deutschen Gemmologischen Gesellschaft, 25. 2. 96-102
Gübelin, E. J. (1978a) Jadeit der grüne Schatz aus Burma, Lapis, 3. 2. 17-28
Gübelin, E. J. (1978c) The tears of Heliades, Gems and Gemology, 16. 3. 66–76


Gübelin, E. J. (1981c) Pakistan enters the gem scene, *Gems and Gemology* 17, 180-181


Hainschwang, T. and Notari, F. (2011) Multi-treated HPHT-grown synthetic diamonds showing some characteristics of natural diamonds. GGTL Laboratories Gemmological Newsletter


Hålenius U., Andreozzi G.B. and Skogby H. (2010) Structural relaxation around Cr3+ and the red-green color change in the spinel (sensu stricto)-magnesiocromite (MgAl2O4 - MgCr2O4) and gahnite-zincocromite (ZnAl2O4 - ZnCr2O4) solid-solution series. American Mineralogist, 95, (4), 456-462.


Halford-Watkins, J.F. (1941) Chalcedony, Gemmologist, 10. 118. 88–91


Hänni, H. A. (1983a) Comparaison chimique de émeraudes-naturelles et synthétiques, Revue de Gemmologie et al., 76. 6-8


Hänni, H. A. (1992a) Considerations terminologiques au sujet des émeraudes du Nigeria de couleur bleu-vert, Revue de Gemmologie a.f.g., 113. 2-4


Hawthorne, F. C. (1987) The crystal chemistry of the benitoite group minerals and structural relations in ($\text{Si}_8\text{O}_{20}$) ring structures, Neues Jahrbuch für Mineralogie Monatshefte, 1, 16-30


Hazen, R.M. and Au, A.Y. (1986) High-pressure crystal chemistry of phenakite ($\text{Be}_2\text{SiO}_4$) and bertrandite ($\text{Be}_2\text{SiO}_4\text{(OH)}_2$). Physics and Chemistry of Minerals 13, 69-78.


Heaney P.J. and Veblen D.R. (1991b) Observation and kinetic analysis of a memory effect at the $\alpha$-$\beta$ quartz transition. American Mineralogist, 76, (9/10), 1459-1466.


Heinrich, E. W. (1963) Paragenesis of clinohumite and associated minerals from Wolf Creek, Montana, American Mineralogist, 48. 5/6. 597-613


Helm, O. (1892) Über Birmit, ein in Oberbirma vorkommendes fossiles Harz, *Schrift Naturforsch Gesellschaft Danzig*, 8, 63-66


Henn, U. (1985a) A comparison of the chemical and optical properties of chrysoberyls from different origins (in German), *Johann Gutenberg Universität Mainz* - *Thesis*, 1-156


Henn, U. (1999b) Synthetische aquamarine im handel, Zeitschrift der Deutschen Gemmologischen Gesellschaft, 48. 3. 163-165
Hertz, W. A. (1912), Burma Gazetteer: Myitkyina District, Rangoon, Superintendent, Govt. Printing and Staty., Volume A, 193 pp., map,
Heung, Y. Y., J. Qin, Y. M. Chang and C. Rudowicz (1994), Correlation of spectroscopic properties and substitutional sites of Cr³⁺ in aluminosilicates - Parts 1 and 2, Physics and Chemistry of Minerals, 21, 8, 532-538 and 526-531.
Hietanen A. (1956), Kyanite, andalusite, and sillimanite in the schist in Boehls Butte Quadrangle, Idaho, American Mineralogist, 41, 1/2, 1-27.
Hietanen, A. (1971) Diopside and actinolite from Skarn, Clearwater County, Idaho, American Mineralogist, 56. 1/2. 234-239
High Pressure Research, 20, (2), 219-227.


Hlawatsch, C. (1909) Die Kristallform des Benitoit, Centralblatt fur Mineralogie, Geologie und Palaeontologie, 10. 293-302


Hofmeister, A. M. and Rossman, G. R. (1985a) Exsolution of metallic copper from Lake County labradorite, Geology, 13. 9. 644-647


Holmes, R. J. and Crowningshield, G. R. (1960) A new emerald substitute, Gems and Gemology, 10. 1. 11-22

http://www.gia.edu/research-resources/news-from-research/index.html
http://www.giathai.net/Red_Feldspar_Special_Report.php


Ingerson, E. and Barksdale, J. D. (1943) Iridescent garnet from the Adelaide Mining District, Nevada, *American Mineralogist*, 28. 5. 303-312


Ito, T. (1947) The structure of epidote (H_Ca_{2}(Al,Fe)Al_3Si_5O_{13}), *American Mineralogist*, 32. 5/6. 309-331


Johnson, M. L. and Kammerling, R. C. (1995b) Some interesting examples of "B-jade" examined at the GIA Gem Trade Laboratory, Hong Kong Jewellery, September, 118-120


Johnson, M. L. and Koivula, J. I. (1996c) Gem materials from the new locality at Tunduru, Tanzania, Gems and Gemology, 32, 1, 58-59


Johnson, M. L. and Koivula, J. I. (1997g) Inclusions-related fluorescence zoning in amber, Gems and Gemology, 33, 4, 301


Johnson, M. L. and Koivula, J. I. (1997m) Tunduru-Songea gem fields in southern Tanzania, Gems and Gemology, 33, 4, 305


Kane, R. E. (1979) "Trapiche" emerald, Gems and Gemology, 16. 7. 211


Kent, D. and Webster, R. (1973) Star-diopside and labradorite as paramagnetic minerals, *Journal of Gemmology*, 13, 8. 308-311


Knoche R., Angel R.J., Seifert F. and Fliervoet T.F. (1998) Complete substitution of Si for Ti in titanite: \(\text{Ca(Ti}_{4-}\times\text{Si}_{4x})_{6}^{17}\times\text{Si}_{6}^{17}\text{O}_{18}\). *American Mineralogist*, 83, (9/10), 1168-1175.
Kocman, V. and Rucklidge, J. (1973) The crystal structure of a titaniferous clinohumite, Canadian Mineralogist, 12. 1. 39-45
Koivula, J. I. (1990b) Gübelin identifies apatite in taaffeite, Gems and Gemology, 16. 12. 409
Koivula, J. I. (1982b) Tourmaline as an inclusion in Zambian emeralds, Gems and Gemology, 18. 4. 225-227
Koivula, J. I. (1984b) Colored stones - emerald, Gems and Gemology, 20. 4. 244
Koivula, J. I. (1984c) Colored stones - chrysoberyl, Gems and Gemology, 20. 2. 121
Koivula, J. I. (1984f) Russian hydrothermal synthetic emeralds, Gems and Gemology, 20. 4. 245
Koivula, J. I. (1985b) Aquamarine, Gems and Gemology, 21. 3. 185-186
Koivula, J. I. (1986a) Amblygonite treatment, Gems and Gemology, 22. 4. 246
Koivula, J. I. (1986b) Electrically treated chalcedony, Gems and Gemology, 22. 4. 246
Koivula, J. I. (1986c) Magnesite, Gems and Gemology, 22. 2. 114
Koivula, J. I. (1986e) Important new amazonite find, Gems and Gemology, 22. 4. 246-247
Koivula, J. I. (1986f) "Rainbow" moonstone, Gems and Gemology, 22. 2. 114
Koivula, J. I. (1987c) "Rainbow moonstones" are labradorite, Gems and Gemology, 23. 3. 175
Koivula, J. I. and Fritsch, E. (1993a) "Denim" lapis lazuli from Afghanistan, Gems and Gemology, 29. 3. 210
Koivula, J. I. and Fritsch, E. (1993b) "Rainbow" hematite from Brazil, Gems and Gemology, 29. 3. 209-210
Koivula, J. I. and Fritsch, E. (1993c) Apatite from Brazil and Madagascar, Gems and Gemology, 29. 1. 53-54
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Koivula, J. I. and Kammerling, R. C. (1991g) Purple and “chrome” green vesuvianites from Quebec, *Gems and Gemology*, 27. 3. 185


Koivula, J. I., Kammerling, R. C. and Fritsch, E. (1992g) Beryl beads with multiple color enhancements, Gems and Gemology, 28. 2. 136

Koivula, J. I., Kammerling, R. C. and Fritsch, E. (1992h) Diopside from Tanzania, Gems and Gemology, 28. 3. 201
InColor


Laird, J. and Albee, A. L. (1972) Chemical composition and physical, optical, and structural properties of benitoite, neptunite, and joaquinite, American Mineralogist, 57. 1/2. 85-102

Landes, K. K. (1938) Origin of the Quebec phlogopite-apatite deposits, American Mineralogist, 23. 6. 359-390


Lee, D. E. (1962) Grossularite-spessartite garnet from the Victory mine, Gabbs, Nevada, American Mineralogist, 47, 1/2, 147-151


Liddicoat, R. T. (1966b) Rare cat's eye, *Gems and Gemology*, 12. 4. 120
Liddicoat, R. T. (1967e) Chrome-rich chalcedony, *Gems and Gemology*, 12. 6. 188-190
Liddicoat, R. T. (1967f) Developments and highlights at the Gem Trade Lab in Los Angeles, *Gems and Gemology*, 12. 6. 183-190
Liddicoat, R. T. (1967g) Developments and highlights at the Gem Trade Lab in Los Angeles, *Gems and Gemology*, 12. 7. 212-222

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Liddicoat, R. T. (1970m) Rare inclusions in synthetic emerald, *Gems and Gemology*, 13. 5. 152-152
Lindner, P. H. and Rolf, A. (1967) Fabulous aquamarines and a huge lilac diamond found in Brazil, Lapidary Journal, 21. 9. 1116-1125
Linley-Shaw, S. (1975) Blue John Stone - its formation, history and working, Lapidary Journal, 29. 7. 1294-1297


Lumpkin, G. R. and Ribbe, P. H. (1979) Chemistry and physical properties of axinites, American Mineralogist, 64. 5/6. 635-645


Mac Fadden, C. K. (1934) Emerald mining in Colombia, Gems and Gemology, 1. 6. 149-154


Macdonald G. A. and R. Merriam (1938), Andalusite in pegmatite from Fresno County, California, American Mineralogist, 23, 9, 588-594.

MacDonald, G. J. F. (1956) Experimental determination of calcite-aragonite equilibrium relations at elevated temperatures and pressures, American Mineralogist, 41. 9/10. 744-756


MacFadden, C. K. and MacDonald, G. J. F. (1934) Emerald mining in Colombia, Gems and Gemology, 1. 6. 149-154

MacFadden, C. K. and MacDonald, G. J. F. (1934) Emerald mining in Colombia, Gems and Gemology, 1. 6. 149-154

MacFadden, C. K. and MacDonald, G. J. F. (1934) Emerald mining in Colombia, Gems and Gemology, 1. 6. 149-154

MacFadden, C. K. and MacDonald, G. J. F. (1934) Emerald mining in Colombia, Gems and Gemology, 1. 6. 149-154

MacFadden, C. K. and MacDonald, G. J. F. (1934) Emerald mining in Colombia, Gems and Gemology, 1. 6. 149-154

MacFadden, C. K. and MacDonald, G. J. F. (1934) Emerald mining in Colombia, Gems and Gemology, 1. 6. 149-154


Manning, P. G. (1967) The optical absorption spectra of the garnets almandine-pyrope, pyrope and spessartine and some structural interpretations of mineralogical significance, Canadian Mineralogist, 9. 2. 237-251

Manson, D. V. and Stockton, C. M. (1982) Gem-quality grossular garnets, Gems and Gemology, 18. 4. 204-213


Mappin, K. G. (1946) An analysis of recent hematite substitutes, Gems and Gemology, 5. 6. 325 and 328


Maschkovtsiev R.I., Smirnov S.Z. and Shigley J.E. (2006) The features of th...
McKie, D. (1963) Order
McKague, H. L. (1964) Trapiche emeralds from Colombia (6), 357
the formation of molecular water and related weakening on heating. Chemical Geology, 220, (1/2), 47-66.
McKague, H. L. (1964) Trapiche emeralds from Colombia - part 1, Gems and Gemology, 11. 7. 210-213 and 223


Medlin, W. L. (1959) The preparation of synthetic dolomite, American Mineralogist, 44. 9/10. 979-986

Meen, V. B. (1966) Both nephrite and jadeite occur in same area in Japan, Lapidary Journal, 20. 1. 42-55


Mitchell, R. H. (1978) Manganoo鞍山 magnesium ilmenite and titanian clinohumite from the Jacupiranga carbonatite, Sao Paulo, Brazil, American Mineralogist, 63. 5/6. 544-547


Moore, P. B. and Bennett, J. M. (1968) Kornerupine: Its crystal structure, Science, 159. 3814. 524-526


Moses, T., Reinitz, I. and McClure, S.F. (1999c) Yellow to yellow-green diamonds treated by HPHT from GE and others, *Gems and Gemology*, 35. 4. 203-204


Nassau, K. (1977a) Irradiation colors in topaz, quartz and beryl, Gems and Gemology, 15, 11. 350-351


Nassau, K. (1980b) Synthetics in the seventies, Lapidary Journal, 34, 1. 50-68


Nassau, K. (1990) Synthetic gem materials in the 1980s, Gems and Gemology, 26, 1. 50-63

Nassau, K. and Jackson, K. A. (1970) Trapiche emeralds from Chivor and Muzo, Colombia, American Mineralogist, 55, 1/2, 416-427
Nel, H. J. (1946) Petalite and amblygonite from Karibib, South West Africa, American Mineralogist, 31, 1/2, 51-57
Nesladek, M., Bogdan, A., Deferme, W., Tranchant, N. and Bergonzo, P. (2008) Charge transport in high mobility single crystal diamond, Diamond and Related Materials, 17, 7/10, 1235-1240
Nickel E H (1968) Structural stability of minerals with the pyrite, marcasite, arsenopyrite and löllingite structures, The Canadian Mineralogist, 9, 311-321


Panjikar, J. (1994) Comparative study of beryl from various Indian occurrences - Beryl from Jammu and Kashmir - Parts 1, 2. Indian Gemmologist, 4, 4. 1.2. 3.83.7

Panjikar, J. and Ramchandran, K. T. (1997) New chrysoberyl deposits from India, Indian Gemmologist, 7, 1&2. 3-7


Payne, C. J. (1955) Ytterbium-doped apatite laser crystals, Engineering and Technology Review, Nov. 5-6

Peacock, M. A. (1938) Supplementary notes on axinite, American Mineralogist, 23, 8. 522-526


Peacock, M. A. (1937) On the crystallography of axinite and the normal setting of triclinic crystals, American Mineralogist, 22, 5. 588-624

Peacock, M. A. (1938) The re-determination of the crystallography of axinite, American Mineralogist, 23, 8. 522-526


Peacock, M. A. (1937) On the crystallography of axinite and the normal setting of triclinic crystals, American Mineralogist, 22, 5. 588-624

Peacock, M. A. (1938) Supplementary notes on axinite, American Mineralogist, 23, 8. 522-526


Pezzotta, F. (2005a) Pezzottaite ad Ambatovita in Madagascar una scoperta tra avventura e scienza, *Rivista Mineralogica Italiana*, 30, 2. 88-103


Pinet, M., D. C. Smith and B. Lasnier (1992), Utilite de la microsonde Raman pour l'identification non-destructive des gemmes (compilation d'une selection representative de leurs spectres Raman), *Revue de Gemmologie a.f.g.*, 111, 11-60.


Pirsson, L.V. (1890) On the fowlerite variety of rhodonite from Franklin and Sterling, N.J. *American Journal of Science* 140, 484-488.


Pough, F.H. (1988a) Gem treatment


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Reeve, R. J. (1972) Brazilianite, Australian Gemmologist, 11. 5. 8-10


Argentine rhodochrosite.


Scarratt, K. (1984g) Notes from the Laboratory: The Angelo imitation pearl. *Journal of Gemmology* 19, 121-123.
Scarratt, K. (1986a) Amber "treatment". *Journal of Gemmology*, 20, 2. 95-97
Scarratt, K. (1992c) Notes from the Laboratory: Dyed and plastic impregnated opal. *Journal of Gemmology* 23. 131-139
Schmetzer, K. (1978a) *Heidelberg University - Thesis*, 1-277
Schmetzer, K. (1985b) Farbloser chrysoberyll - Natürlich oder synthetisch?, *Zeitschrift der Deutschen Geologischen Gesellschaft*, 34. 1/2. 6-12


Schmetzer, K. (1987a) Lamellare einschaltungen von diaspor in korund, Der Aufschluss, 38. 3. 335-337


Schmetzer, K. (1988c) Zur charakterisierung von synthetischen, im hydrothermalverfahren gezüchteten russischen smaragden, Deutsche Goldschmiede Zeitung, 86. 11. 97-102


Schmetzer, K. (1990a) Lechleitner synthetic emeralds, rubies and sapphires, Deutsche Goldschmiede Zeitung, 11. 90-93

Schmetzer, K. (1990b) Synthetische Smaragde, Rubine und Saphire nach Lechleitner, Deutsche Goldschmiede Zeitung, 11. 90-93


Schmetzer, K. (1999a) Clues to the process used by General Electric to enhance the GE POL diamonds, Gems and Gemology, 35. 4. 186-190


Schmetzer, K. (2002) Das neue Screening-System zur Erkennung der HPHT-Behandlung natürlicher Diamanten, Deutsche Goldschmiede Zeitung, 100. 5. 88


Schmetzer, K. and Bank, H. (1980c) The alexandrite effect in minerals: Chrysoberyl, gamet, corundum, fluorite, Neues Jahrbuch für Mineralogie Abhandlungen, 138. 2. 147-164


Schmetzer, K. and Ottemann, J. (1979b) Zur identität von lawrowit, Neues Jahrbuch für Mineralogie Monatsshefte, 4. 189-192
Schmetzer, K., Bank, H. and Stähle, V. (1981a) The chromium content of Lechleitner synthetic emerald overgrowth, Gems and Gemology, 17. 2. 98-100
Schmetzer, K., Peretti, A., Medenbach, O. and Bernhardt, H. J. (1997) Im flussmittelverfahren gezuchteter synthetischer alexandrit aus Russland, Deutsche Goldschmiede Zeitung, 95. 181-185
Schnellrath, J. (1990) Brasilianische andalusite und zink-staurolithe von edelsteinqualitat; Chemismus, bildungsbedingungen, optische und krisallographische Eigenschaften, Kurzmitteilungen aus dem Institut fur Edelsteinforschung, 5. 1/2. 5-8


Shannon, E. V. (1923) Note on cobaltiferous gahnite from Maryland, American Mineralogist, 8, 8. 147-148


Shaub, B. M. (1979) Genesis of thunder eggs, geodes, and agates of igneous origin, Lapidary Journal, 32, 11,12, 2340-2354, 3548-2566


Shida, J. (1998b) CL and other characteristics of various type of yellow diamonds, Gemmology, 29. 340. 24-26


Shipley, R. (1942) Synthetic emeralds appear commercially in small quantities, Gems and Gemology, 4. 3. 40 and 42.


Stephenson J., Kouznetsov N. (2009). Major deposits of demantoid�


Ten, S. T. W. (1989b) How to identify the new jadeite imitation, Jewelry Circle Magazine, 12, 6-8


Tenhagen, J. W. (1972) Muzo emerald mine: A visit, Gems and Gemology, 14. 2. 77-81


Trossarelli, C. (1986) Synthetic alexandrite from USSR (in Italien), La Gemmologia, 11, 4, 6-22


Trumper, L. C. (1949) Komerupine find, Gemmologist, 18, 212. 71-72


Xu, Z. and Sherriff, B.L. (1994) $^{23}$Na $^{27}$Al $^{9}$Be $^{28}$Si solid state NMR study of tugtupite. Canadian Mineralogist 32, 935-943.


Zachariasen, W. H. (1930) The crystal structure of benitoite, BaTiSi$_3$O$_9$, Zeitschrift fur Kristallographie, 74. 139-146.


Zwaan P.C. (1992) La kornerupine d'Embilipitiya, Sri Lanka, Revue de Gemmologie a.f.g., 110. 5-6

Zwaan P.C. (1996) Enstatite, cordierite, kornerupine, and sacpolite with unusual properties from Embilipitiya, Sri Lanka, Gems and Gemology, 32. 4. 262-269

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