



Rocks and Minerals for the Classroom Series

1. Minerals for the Classroom

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Teacher
Earth
Science
Education
Programme Ltd



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- Sydney Mineral Exploration Discussion Group (SMEDG)



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In-kind support

- AusGeol.org – Virtual Library of Australia's Geology
- Australian Geoscience Council
- Australian Museum
- Australian National University – RSES
- Australian Rare Earths Ltd
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- BHP Olympic Dam
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- Alkane Resources Ltd
- Astron Corporation (Donald Mineral Sands)
- Atmos Renewables (Cherry Tree Windfarm)
- Aurelia Metals Ltd (Peak Gold Mines)
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- Kingston Resources Ltd (Mineral Hill)
- Linex Pty Ltd
- MACH Energy
- Mercator Gold Australia Pty Ltd
- Navarre Minerals
- OZ Minerals
- Providence Gold Minerals Pty Ltd
- Stawell Gold Mine
- Sydney Mineral Exploration Discussion Group (SMEDG)
- Whitehaven Coal

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We wish to acknowledge the Traditional Owners of the land on which we meet today.

We also wish to pay our respects to Elders past, present and future.



All TESEP webinars are recorded

After each webinar episode you will be sent a link with:

- access to the slide set for that episode (including any embedded videos and links)
- access to a recording of that episode (YouTube)

After each episode you will also be sent:

- A Certificate of Attendance

Please [subscribe](#) for news about forthcoming and new webinar series!



Australian Curriculum v.9 (F-10)

We will be following the Australian Curriculum v.9 (2022):

- Curriculum content for Years 7-10 only
- Focus on the Earth and Space science sub-strand
- Will follow as many other sub-strands as possible



Australian Curriculum v.9 (F-10)

Much of this webinar is dedicated to Year 8, “... continue to develop a view of Earth as a dynamic system, in which change occurs across a range of timescales”.

Rocks and Minerals for the classroom, and Plate Tectonics webinars cover this fully.

This webinar Series will follow the following sub-strands:



Australian Curriculum v.9 (F-10)

AC9S8U04 “describe the key processes of the rock cycle, including the timescales over which they occur, and examine how the properties of sedimentary, igneous and metamorphic rocks reflect their formation and influence their use”

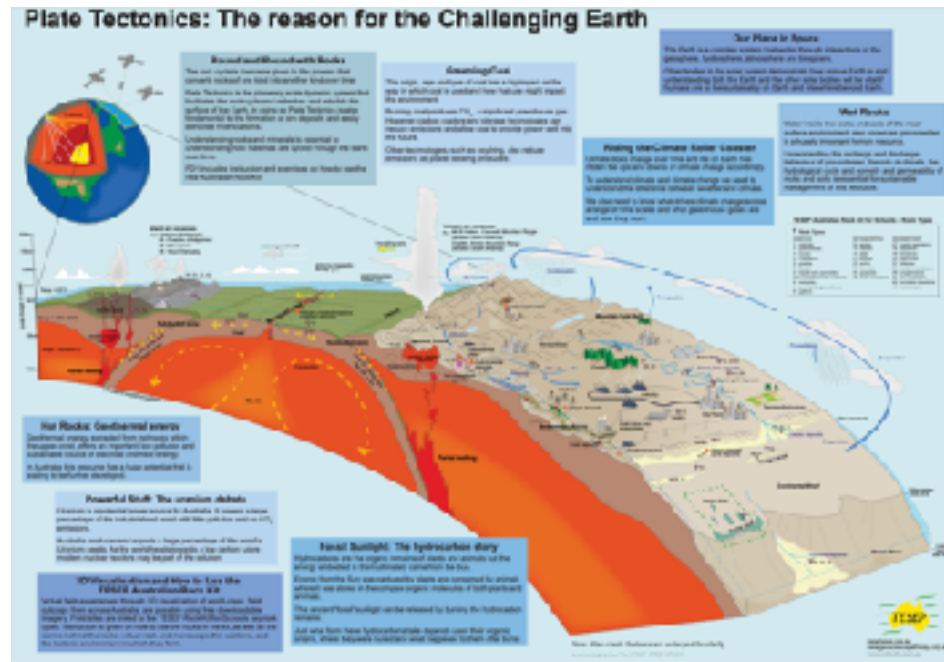
AC9S8H01

“explain how new evidence or different perspectives can lead to changes in scientific knowledge”.

<https://v9.australiancurriculum.edu.au/>

With a knowledge of minerals and rocks, and how they form, it is very difficult to teach plate tectonics.

TESEP Rock Kit and Plate Tectonics Poster



A great to teach where rocks form and the industries that extract and use them.

Get them from haines.com.au or host a [PD at your school!](#)

You can also get them as a [bundle](#)

TESEP Rock and Mineral Check



With each School visit we offer a free rock and mineral check:

- To identify specimens no longer useful for teaching (e.g., pebbles, small specimens etc.)
- To identify any misplaced specimens or valuable specimens (for display only)
- To identify any hazardous material (e.g., asbestos, pitchblende etc.)

TESEP Rock Kit and Plate Tectonics Poster



The rock kit (and rock numbers) will be referred to in each episode



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TEACH EARTH SCIENCE WITH CONFIDENCE

Teacher Earth Science Education Programme Ltd (TESEP) provides:

- Australia-wide STEM Professional Development (PD) workshops
- Webinars
- Field Trips
- Rock and Mineral Kits
- Plate Tectonics Poster
- Classroom incursions
- Rock and mineral collection checks
- Free online resources

Let our team of dedicated Earth and Environmental Scientists help you better understand the Earth and Space Science as well as the Primary and Senior Secondary Earth and Environmental Science Curriculum.

Browse our range of webinar and PD workshop topics here.

Attend one of our Australia-wide free webinars or PD events or host your own PD workshop at your school.

TESEP is an Australian Charities and Not-for-profits Commission (ACNC) Registered Charity. See our Registered Charity Tick [here](#).



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NEW TESEP Ltd Website

TESEP Webinars

Webinars are held after school and each episode runs between 45-60 minutes. Extra time for Q&A can follow as required.

Covers Version 9.0 Australian Curriculum (Earth and Space Sciences)

Attendees will receive a TESEP Certificate of Attendance and will be sent a link to the recording and a pdf of the slide pack.

Please subscribe [here](#) to the TESEP mailing list to receive emails about webinar and other TESEP events twice a Term.

Webinars

Special Webinars

Rocks & Minerals for the Classroom

Understanding the characteristics and classification of rocks and minerals is vital to teaching Earth and Environmental Sciences. In this webinar we ask: What makes a good mineral and rock for use in classroom teaching? What doesn't? What minerals and rocks shouldn't be in the classroom at all?

Term 2

[Register](#)

Webinar covers the new Version 9.0 Australian Curriculum (Earth and Space Sciences), namely: AC958U04, AC958H01 (Year 8).

Plate Tectonics

Plate tectonics explains the landforms we are familiar with on Earth today – as well as those from the past. The Plate Tectonics webinar series will examine the development of the plate tectonic theory, the mechanisms for plate movement, and the effect of plate tectonics including where and how different rocks and natural resources form, and hazards like volcanoes and earthquakes. This workshop is highly relevant to the Year 8 science curriculum and includes suggested activities for the classroom.

Term 2

[Register](#)

The content covers the new Version 9.0 Australian Curriculum (Earth and Space Sciences), namely: AC958U03, AC958H01, AC958H01 (Year 8).

Why teach rocks and minerals?

Building blocks of our planet
(accessible to all)

Natural resources that we use daily
(e.g., nutrition, climate, technology)



Hands on
(great to use in class)

Link to other subjects
(chemistry, physics, biology, geography)

What are minerals?

Minerals are solid chemical compounds

Formed by natural processes*

Stable or metastable at Earth's surface (25°C & 1 atm)*

A regular chemical formula*

Ordered atomic arrangement (crystalline)*

Usually abiogenic*

* There are exceptions



Characteristics of Minerals

Ordered atomic arrangement (crystalline)

- Euhedral – Completely bounded by crystal plane faces
- Subhedral – Incompletely bounded by crystal plane faces
- Anhedral – No crystal plane faces (no crystal habit)



Euhedral



Subhedral



Anhedral

Habit

External shape of crystal under ideal growing conditions



Stalactitic



Globular



Hexagonal

Colour

Colour can be definitive

Sulphur



Azurite



Colour can also change (poor diagnostic character)

Quartz



Streak

Colour of the mineral powder when scratched on a streak plate

Streak is often different to the colour of the mineral itself



Lustre

Amount and colour of light emitted



Metallic



Adamantine



Vitreous



Dull



Silky



Resinous

Diaphaneity (Transparency)

Relative ability to transmit light



Transparent Transmits distinct images

Semi transparent Can see image, but not distinctly

Translucent Light but not images

Sub-translucent Some light at edges

Opaque No light transmitted

Hardness

Resistance to scratching

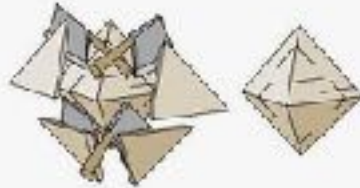


Mohs scale of hardness

Cleavage

A mineral's tendency to break along well-defined planes of weakness

Related to the atomic structure of the mineral



Fluorite has four good directions of cleavage (octahedral cleavage)



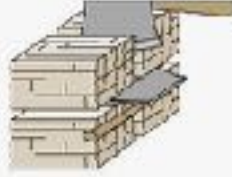
Calcite has three good directions of cleavage that form angles of 105 deg. in one plane and 75 deg. in another



Galena has three good directions of cleavage that form two 90deg. angles (cubic cleavage)



Hornblende (an amphibole) has two good directions of cleavage at 124 deg. from each other.



Orthoclase and plagioclase feldspars exhibit two good directions of cleavage at approximately 90deg from each other



Biotite and muscovite micas exhibit one excellent direction of cleavage.

The cleavage is often not easy to find

Not all minerals exhibit cleavage

Do not need to break samples to find cleavage

Fracture

Irregular breaking of minerals

Conchoidal Semicircular shell, with a smooth, curved surface.

Uneven Rough or irregular surface.

Hackly Broken metal, with rough, jagged, points. True metals exhibit this fracture.

Splintery Elongated splinters. All fibrous minerals fall into this category.

Earthy or crumbly This describes minerals that crumble when broken.

Crystallinity

The shape and size of a crystal

Crystallised Well developed crystals

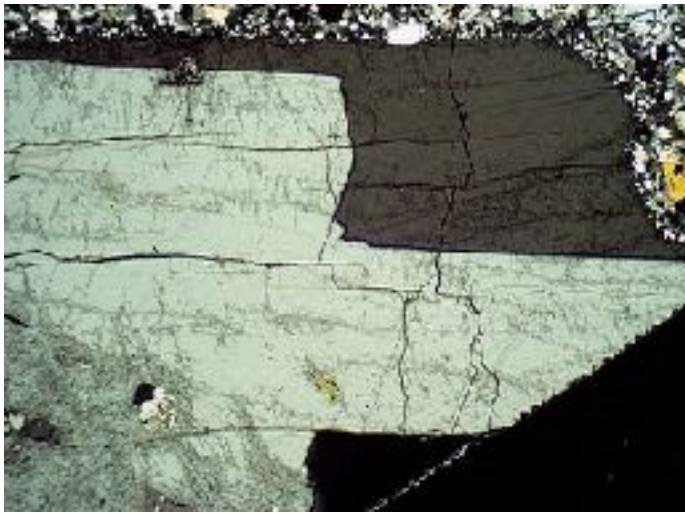
Crystalline No definite crystals but imperfectly formed crystal grains

Microcrystalline Traces of crystalline structure (can see crystals under microscope)

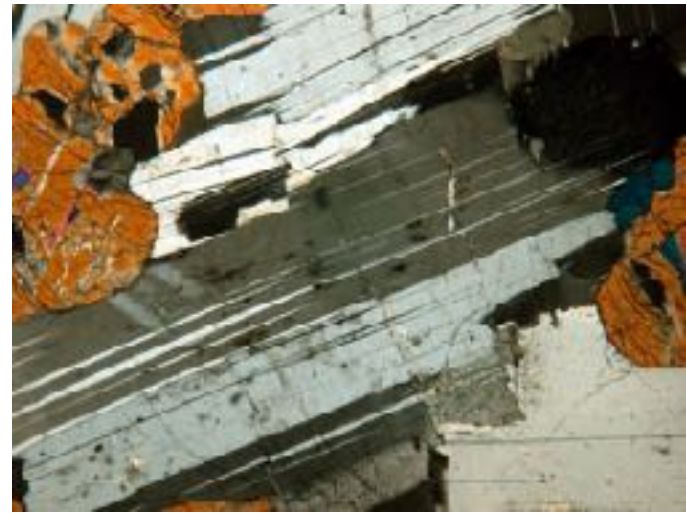
Amorphous No crystalline structure (like glass)

Twinning

When two separate crystals share part of the same crystal lattice points in a symmetrical manner



Simple twinning Orthoclase



Multiple twinning Plagioclase

Specific Gravity

Weight of a mineral to and equal amount of water

Magnetism

Whether a mineral can repel or attract other magnetic materials

Taste

What a mineral tastes like (please do not put minerals in your mouth)

Odour

What a mineral smells like when moistened, heated or rubbed

What are Minerals? Summary

In summary ...

A mineral is an element or chemical compound that is normally crystalline and that has been formed as a result of geological processes.

A mineral is a naturally occurring inorganic solid.



Minerals for the classroom

Which ones are important?

It depends!

Student engagement



Minerals are exceptionally good engagement / stimulus tools. They can be used in a variety of cross-curricular settings using:

- Crystal habit
- Colour
- Density / SG
- Lustre
- Magnetism
- Amount of Transparency (Diaphaneity)
- Hardness & Cleavage



Minerals for the classroom

Silicates ...

- Feldspars (plagioclase and orthoclase)
 - Quartz
 - Pyroxenes
 - Amphiboles
 - Micas (muscovite and biotite)
 - Olivine

Non-Silicates ...

- Carbonates
 - 3 main types
- Oxides
 - 2 main types

Silicates

Feldspars



Potassium Feldspar
 KAlSi_3O_8



Plagioclase Feldspar
 $\text{NaAlSi}_3\text{O}_8 - \text{CaAl}_2\text{Si}_2\text{O}_8$

Silicates

Quartz



Quartz
 SiO_2

Silicates

Pyroxenes



Pyroxene
 $(\text{Mg,Fe,Ca,Al})\text{SiO}_3$

Silicates

Amphiboles



Amphibole
 $(\text{Mg, Fe, Ca, Na})\text{Si}_8\text{O}_{22}(\text{OH})_2$

Silicates

Micas



Muscovite
 $\text{KAl}_3\text{Si}_3\text{O}_{10}(\text{OH})_2$



Silicates

Micas



Biotite



Silicates

Olivine



Olivine
 $(\text{Mg,Fe})_2\text{SiO}_4$



Non-Silicates

Carbonates



Calcite
 CaCO_3



Dolomite
 $\text{CaMg}(\text{CO}_3)_2$



Magnesite
 MgCO_3

Non-Silicates

Oxides



Magnetite
 Fe_3O_4



Hematite
 Fe_2O_3



Minerals for the classroom

When teaching rock forming minerals ...

... they **must be large**, show main features such as cleavage

- Feldspars
 - White and Pink
- Quartz
- Pyroxenes → hard to get good examples
- Amphiboles → hard to get good examples
- Micas
 - White and Black
- Olivine
- Carbonates
 - Calcite plus dolomite
- Oxides
 - Iron oxides

Other minerals

Metamorphic minerals



Staurolite

Other minerals

Metamorphic minerals



Andalusite
 Al_2SiO_5



Sillimanite
 Al_2SiO_5



Kyanite
 Al_2SiO_5

Other minerals

Metamorphic* minerals



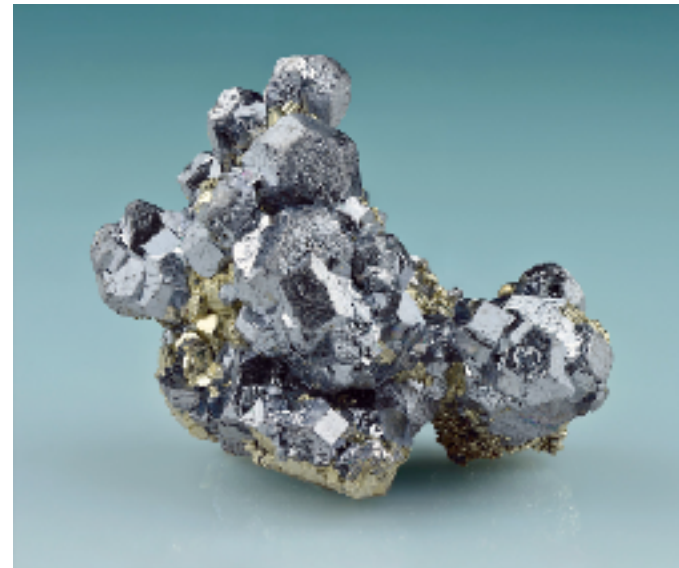
Garnet
 $(\text{Fe, Mg, Ca, Mn})_3\text{Al}_2(\text{SiO}_4)_3$

**Garnets can also form in igneous rock*

Other minerals

Ore minerals - sulphides

- Sulphides form masses of rock too
 - Rare concentrations we call metalliferous ore
- Form by geological processes, often imposed on other rocks
 - Important sources of some metals – Cu, Pb, Zn
- Not important rock forming minerals





Minerals for the classroom

Other minerals ... to be aware of ...

Clays

- Clays are silicate minerals and are very important
 - Weathering products of many other silicates
 - Significant constituents of many sedimentary rocks

Additional oxides and native elements

- Corundum Al_2O_3 – Ruby & Sapphire
- Limonite & Goethite $\text{FeO}(\text{OH}) \cdot n\text{H}_2\text{O}$ & $\text{FeO}(\text{OH})$
- Gold, Silver, Copper
- Graphite & Diamond

Minerals to avoid



Crocoite - Lead Chromate PbCrO_4

Minerals to avoid



Asbestos: Chrysotile/Amosite/Crocodolite/Tremolite/Anthophyllite

Minerals to avoid



Pitchblende (Uraninite) - UO_2/UO_3

Minerals to avoid



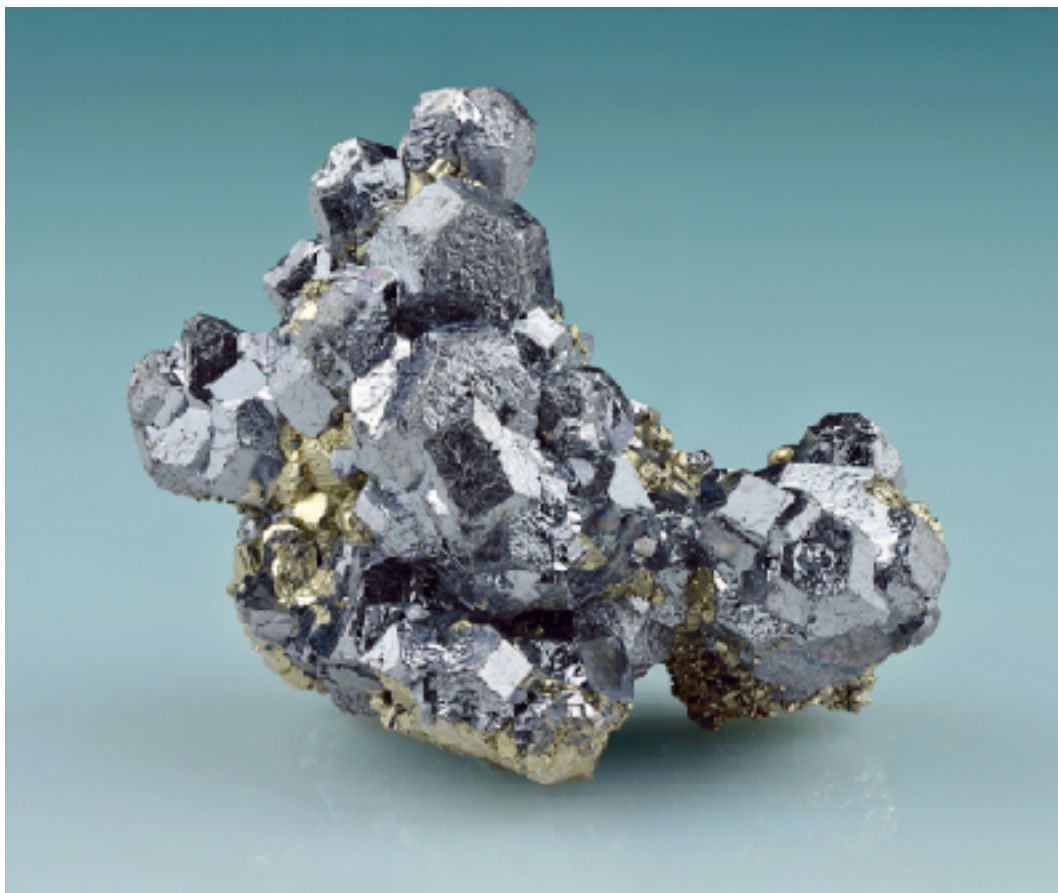
Orpiment – As_2S_3

Minerals to avoid



Cinnabar - HgS

Minerals to avoid*



Galena PbS (can be contained)



Minerals to avoid

Any rock with 'bad' minerals

Be **wary** of any rock from ...

Rum Jungle

Mary Kathleen

Olympic Dam

→ Potentially radioactive minerals

Mt Isa

Broken Hill

Olympic Dam

→ potentially hazardous minerals and/or heavy metals



What makes a good mineral?

Size

Large enough handle easily and see key features

Features

Conforms to expected features for that mineral type

Cleavage

Hardness

Streak

Lustre

Colour etc

Safe to handle

Some minerals OK in some classes and not others!



What makes a poor mineral?

Size

Too small to handle easily and see key features

Features

Does not obviously show expected features for that mineral type

Cleavage absent or wrong

Hardness outside usual range

Streak contaminated with blebs of other mineral

Lustre not as expected

Colour etc outside of usual range

Rare and of little interest

Unsafe to handle or falls apart too easily

Some minerals OK in some classes and not others!

Geoscience Australia – Education Centre

Online resources and classroom activities for Australia's geology, minerals, energy, natural hazards and more



Australian Government
Geoscience Australia

Visit them!

- Purpose built Education Centre in Canberra
- Student-activity education
- Earthquake and tsunami monitoring
- Touch the only piece of the Moon in the Southern Hemisphere
- Geological time walk with representative Australian rocks
- National rock, mineral and fossil display – including meteorites

<https://www.ga.gov.au/education>



Links to online resources

Not for profit organisations ...

TESEP:

<http://www.tesep.org.au>

Geoscience Pathways Project

www.geosciencepathways.org.au

Aus Earth Ed:

<https://ausearthed.com.au/>

CoRE Learning Foundation

<https://www.corefoundation.com.au/>

Ore Some Resources:

<https://www.oresomeresources.com/>

Geological Surveys and professional groups ...

Geoscience Australia:

<https://www.ga.gov.au/education>

British Geological Survey – Education

<http://www.geomag.bgs.ac.uk/education/home.html>

United States Geological Survey

<https://www.usgs.gov/educational-resources>

Kentucky Geological Survey (classroom activities):

<https://www.uky.edu/KGS/education/classroom-activity.php>

Minerals Council of Australia (Australian minerals facts):

<https://minerals.org.au/about/mining-facts/>

NSW Mining (Hunter Valley Mine Tours):

<https://miningdialogue.com.au/engagement/school-tours>

Opportunities for keen and talented students

Olympiads and Fairs ...

Australian Science Olympiads

<https://www.asi.edu.au/program/australian-science-olympiads/>

International Earth Science Olympiad

<https://www.igeosced.org/>

Australian Science and Engineering Fair

<https://aussef.com.au/>

International Science and Engineering Fair

<https://www.societyforscience.org/isef/>

Local geology and earth science societies ...

Geotrails in Australia (AGC)

<https://www.agc.org.au/geoscience-in-australia/geotourism/inventory-of-geotrails-in-australia/>

Geological Society of Australia (talks and field trips across Australia)

<https://www.gsa.org.au/>

Field Geology Club of SA

<https://fieldgeologyclubsa.org.au/>

Amateur Geological Society of the Hunter Valley

<https://agshv.com/>