Surface rocks

Australia's land surfaces, as elsewhere on the earth, consist of varying proportions of hard rock, loose unconsolidated sediments and soil.

A knowledge of lithology—the study of the physical and chemical composition of rocks—helps in the understanding of the history and structure of the earth's crust. Many mineral deposits of economic importance, for example, are found in certain types of rock. Rock type also influences soil fertility, the quantity and quality of groundwater, soil stability for engineering projects such as the building of roads and dams, and the availability of construction materials.

The map 'Surface Rocks' opposite shows in a generalised way where the main kinds of rocks and derived material occur. The rocks are broadly classified into five major categories according to the main processes by which they were formed.

Igneous rocks

Igneous rocks originate deep within the earth. They are forced through pressure into the upper layers of the crust or onto the surface, generally as a hot fluid or plastic mass which subsequently cools and solidifies into a hard, dense crystalline rock.

Volcanic (extrusive) rocks

- extruded as lava onto the land surface and sea floor
- having solidified quickly they are typically fine-grained and may have a glassy texture

Acid volcanic rocks

- have a high silica content, are light in colour and have solidified from lava of low viscosity
- mostly evident as exposed volcanic plugs, e.g. rhyolite

Basic volcanic rocks

- have a low silica content but are generally rich in iron and manganese minerals and hence dark in colour; have solidified from lava with a high viscosity
- occur most commonly as extensive basalt lava flows

Intrusive rocks

- solidified lava intruded into surrounding rocks and exposed at the surface by erosion
- occur as extensive sheet-like layers or large broadly spherical bodies (batholiths)
- having solidified slowly they are usually coarse textured, with large crystals

Acid intrusive rocks

- high in silica and hence light coloured and coarsely textured, often with large crystals
- most commonly granite, occurring at the surface as large exposed batholiths forming mainly upland areas

Basic & ultrabasic intrusive rocks

- have a low silica content but are richer in iron and other metallic minerals; usually coarsely textured, dark crystalline rocks
- commonly dolerite (though not as widespread as granite), usually occurring as dykes and sills in association with basic extrusive volcanic activity

Sedimentary rocks

Sedimentary rocks are produced by the cementing of unconsolidated sediments (generally under the weight of overlying material) into a cohesive, granular mass. The raw materials are derived from the erosion of previously existing rocks. They have been deposited as layers, mostly in marine conditions.

Siltstone, shale and mudstone

- consolidated very fine particles
- fine texture

Sandstone

- silica grains, usually cemented together by other minerals
- medium texture

Conglomerate, tillite and breccia

- mainly products of fluvio-glacial erosion and deposition
- conglomerate—rounded gravel and boulders cemented together
- tillite—consolidated clay of glacial origin
- breccia—shattered angular rock fragments bound together
- conglomerate and breccia are very coarsely textured; tillite has a very fine texture

Limestone and dolomite

- limestone—consists mainly of calcium carbonate; formed under water either by slow deposition of shells and animal skeletons or precipitated from calcium-rich sea water
- dolomite—a carbonate rock rich in both calcium and magnesium

Banded iron formation

- a finely-banded rock consisting of alternating layers of silica and high grade iron ore

Metamorphic rocks

Metamorphic rocks are formed by the alteration of igneous and sedimentary rocks under conditions of high pressure and temperature. Pre-existing metamorphic rocks can be further altered over time. New minerals formed during metamorphism reflect not only the temperature and pressure but also the composition of the pre-existing rock.

Classification of metamorphic rocks

- metamorphic rocks can be classified according to their degree of alteration
- the rocks least altered are termed 'low grade'; those most altered are 'high grade'

Low grade metamorphic rocks

- closely resemble the original parent material
- include rocks such as slate (slightly altered siltstone) and phyllite (slightly altered shale)

Medium to high grade metamorphic rocks

- pronounced alteration from parent material, with significant increase in hardness
- includes rocks such as marble (a highly altered limestone) and gneiss (a hard, banded rock derived from various parent rock types)

Surficial deposits and weathering mantles

Surficial deposits consist of unconsolidated erosional material which overlays the bedrock. They have been deposited mainly by water and wind, and range from a thin layer of sand to deep alluvium and clay. Weathering mantles are zones of decayed bedrock which have developed *in situ* at or near the surface.

Surficial deposits

Alluvial material

- clay, silt, sand and gravel transported in streams and deposited in stream beds, floodplains, deltas, etc.

Colluvial material

- rock debris accumulated at the base of slopes through downhill movement

Quartz sand

- sand with a high silica content forming dunes and plains. Sandplains result from wind removing finer material; dunes from the accumulation of wind-blown sand

Evaporite

- deposits formed by the evaporation of saline water and the precipitation of salts in lakes and coastal lagoons
- common evaporites in Australia are gypsum and salt

Weathering mantles

Laterite

- a hard capping resulting from seasonal weathering of surface bedrock, usually under tropical conditions
- some elements have been leached out while others have been concentrated at the surface
- the main Australian laterites are bauxite (mined for aluminium) and iron-rich ferricrete

Silcrete

- a hard capping developed through enrichment of surface material by silica

Calcrete

- calcium concentrated in surface horizons of soils to form a hard sheet

Calcarenite

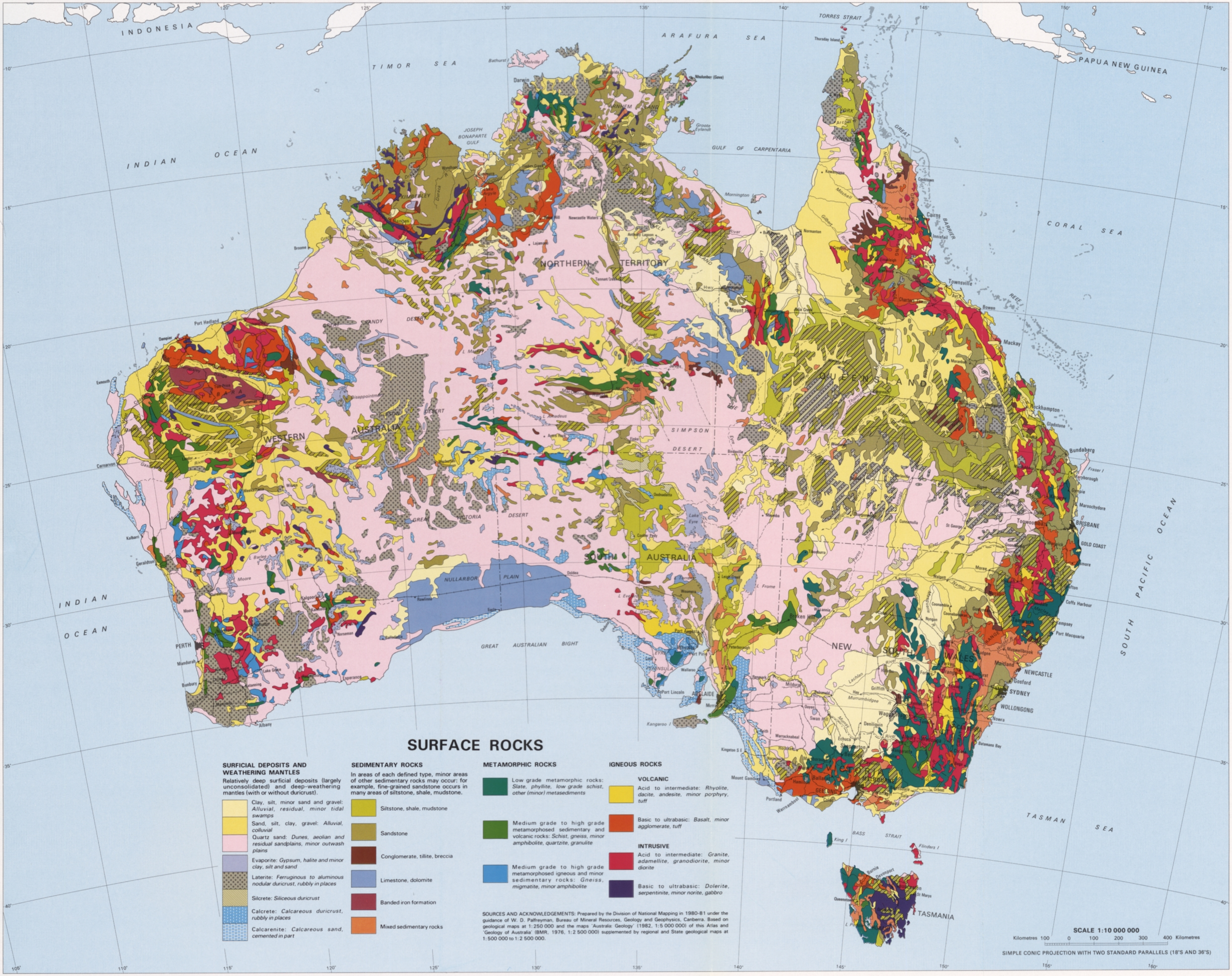
- sand deposited in dunes and partially calcified

1. Sheets of dolerite—a basic igneous rock—which were intruded during the Jurassic, now stand exposed to form the higher peaks of eastern and central Tasmania. Hard igneous rocks make up many of Australia's higher erosional surfaces.

2. Hawkesbury Sandstone, still maintaining near-horizontal bedding planes formed during deposition in a Jurassic sea, today forms extensive plateaux around Sydney. Sedimentary rocks like this make up many of Australia's moderately high erosional surfaces such as the Kimberley and Arnhem Land plateaux, and the Blue Mountains illustrated here.

3. Rock strongly metamorphosed to a hard gneiss by the nearby intrusion of a granite batholith. The paler contorted veins of pegmatite were injected from the batholith into the darker gneiss. Together, metamorphic and igneous rocks form most of Australia's higher erosional surfaces.

4. Hard laterite or silcrete capped mesas are common throughout Australia's arid interior. Below the silcrete capping of the mesa shown here are colluvial fans of rock debris spreading down the escarpment to surrounding sandplains. Many types of parent rock have weathered to form hard mantles (duricrust), such as laterite and silcrete, which now make up most of Australia's moderately high and lower erosional surfaces. Sandplains and dunefields form the largest areas of recent deposition.



SURFACE ROCKS

SURFICIAL DEPOSITS AND WEATHERING MANTLES

Relatively deep surficial deposits (largely unconsolidated) and deep-weathering mantles (with or without duricrust).

- Clay, silt, minor sand and gravel: *Alluvial, residual, minor tidal swamps*
- Sand, silt, clay, gravel: *Alluvial, colluvial*
- Quartz sand: *Dunes, aeolian and residual sandplains, minor outwash plains*
- Evaporite: *Gypsum, halite and minor clay, silt and sand*
- Laterite: *Ferruginous to aluminous nodular duricrust, rubbly in places*
- Silcrete: *Siliceous duricrust*
- Calcrete: *Calcareous duricrust, rubbly in places*
- Calcarenite: *Calcareous sand, cemented in part*

SEDIMENTARY ROCKS

In areas of each defined type, minor areas of other sedimentary rocks may occur: for example, fine-grained sandstone occurs in many areas of siltstone, shale, mudstone.

- Siltstone, shale, mudstone
- Sandstone
- Conglomerate, tillite, breccia
- Limestone, dolomite
- Banded iron formation
- Mixed sedimentary rocks

METAMORPHIC ROCKS

- Low grade metamorphic rocks: *Slate, phyllite, low grade schist, other (minor) metasediments*
- Medium grade to high grade metamorphosed sedimentary and volcanic rocks: *Schist, gneiss, minor amphibolite, quartzite, granulite*
- Medium grade to high grade metamorphosed igneous and minor sedimentary rocks: *Gneiss, migmatite, minor amphibolite*

IGNEOUS ROCKS

VOLCANIC

- Acid to intermediate: *Rhyolite, dacite, andesite, minor porphyry, tuff*
- Basic to ultrabasic: *Basalt, minor agglomerate, tuff*

INTRUSIVE

- Acid to intermediate: *Granite, adamellite, granodiorite, minor diorite*
- Basic to ultrabasic: *Dolerite, serpentinite, minor norite, gabbro*

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