Identifying Sedimentary Rocks – Teacher Background

Sedimentary rocks are formed from clasts (broken pieces) of earlier rock and organic material. They are the product of weathering, erosion, deposition, compaction and cementation.

1. **Sedimentary strata** are groups of the same kind of rocks. They are composed of fragments of older rocks and organic material. These can be many hundreds of metres thick and can be followed across great geographical distances. They represent deposition over long geological period. *e.g. Eocene strata underlies most of the Eucla basin and was deposited between 34 and 55 million years ago.*

Massive cross-bedded sandstone strata in Mt Zion USA (courtesy of Lawrie Davidson)

2. **Sedimentary beds** are much smaller and have distinct depositional boundaries e.g. Dune bedding in sandy limestone and cross bedding in river delta deposits. These can be mm to m thick and represent deposition over a short geological period.

Sand and silt beds from the Collie coal field

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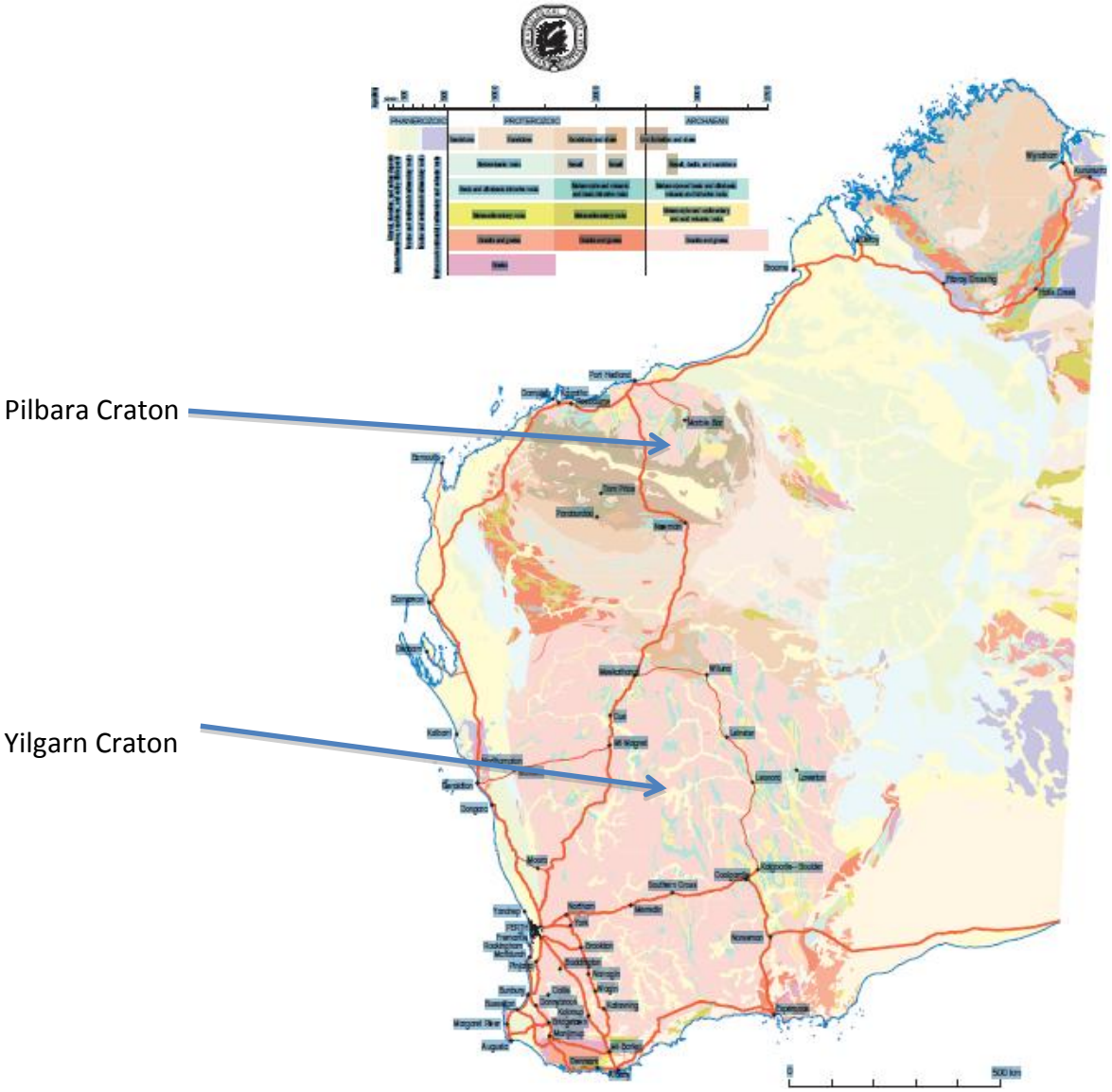
Sedimentary rocks are presently being deposited in the five great basins of Western Australia, the Perth Basin, the South and North Carnarvon Basins, the Canning Basin and the Eucla Basin, where they are being actively prospected for oil and gas.

Sedimentary basins surround our two ancient cratons, the Yilgarn craton and the Pilbara craton. Cratons are large bodies of igneous and metamorphic rock (coloured pink on the map) which have been largely unchanged for billions of years. It is from the weathered and eroded material from these cratons that our sediments are formed.

Geological map of Western Australia
(Courtesy of GSWA)



Large copies of this map can be obtained from the Geological Survey of Western Australia or by contacting Earth Science Western Australia through our website www.earthsciencewa.com.au

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Sedimentary rocks are classified as being composed of:

A. **Clastic sediments**
B. **Biogenic sediments**
C. **Chemical sediments**

Many rocks can have a combination of all three types. e.g. limestone can be assembled from fragments of shell, grains of sand and be cemented by chemicals in groundwater.

A. Clastic sediments

These are classified according to clast size. Clasts are broken bits of earlier rock which are compacted and cemented to make the new rock.

Breccia

Breccia (Italian –broken) is similar to conglomerate but the large unsorted clasts are quite angular. Many breccias represent scree or talus materials that lay along hill slopes or cliff bases like the scree deposits present along the face of the Darling Scarp.

Angular talus of banded Iron Formation

Talus compacted and cemented to form breccia

Conglomerate

Conglomerate is a poorly sorted rock with rounded pebbles over 2mm in size set in a fine or medium grain matrix. It forms when mountains are being rapidly eroded by water. The pebbles become rounded in mountain streams but are dropped unsorted when the streams arrive at the plain and lose energy to carry material.

Rounded pebbles from river

Compacted and cemented to form conglomerate

Sandstone

Sandstone is usually well sorted and demonstrates bedding. Each bed demonstrates grain size decreasing upwards. Clasts are usually between 2mm and 1/256mm and are easy to feel. Sandstones are usually deposited by wind or water. Desert sandstones have well rounded polished or frosted surfaces due to impact and tend to be red. Sandstones can be cemented by silica or carbonates.

Students visiting dune sands

Compacted and cemented to form sandstone

Siltstone

Siltstone has fine clasts that can just be discernable by the naked eye. (Their grittiness can just be felt by dragging the rocks across your teeth – not to be recommended in class!). It tends to be grey, brown and black and often shows fine laminated bedding.

Siltstone from the Irwin River

Siltstone forms from sea, river and lake sediments.

Mudstone
Mudstone is fairly homogenous and formed from clay minerals. Clays are flat lightweight alumina-silicates and are easily transported out into deep water before deposition. Mudstone also forms under coastal lagoonal swampy conditions.


Student with mud

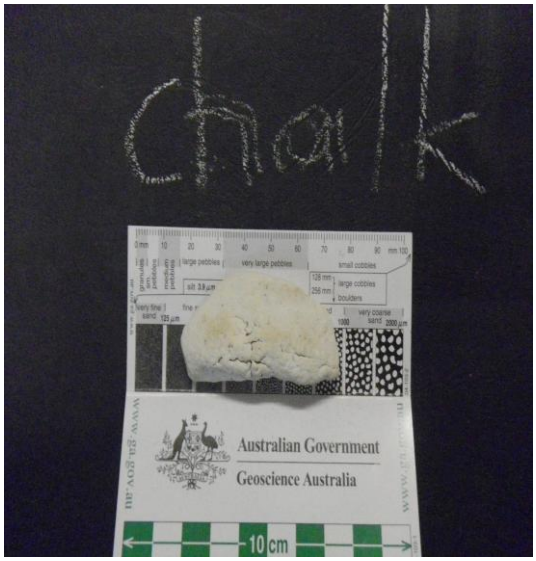
Mudstone

Mudstone tends to be grey or black and the grains (<1/256mm) are too small to be seen by the naked eye. The rocks often feel smooth and silky.

B. Biogenic sedimentary rocks
The most common biogenic rocks in Western Australia are coal, chalk, spongelite and reef limestone. (Humans can deposit bile salts to form kidney stones which can fall into this classification!)

Coal is formed from carbon rich organic matter deposited in ancient swamps. The anaerobic conditions preserved the organic material. It is black or grey and may or may not contain fossils. Most coal around the world formed in the Carboniferous Period however our coal in Western Australia is much younger being Permian in age (270my). Coal is found in the Collie and Irwin basins. Most of Western Australia's electricity is produced in coal-powered stations

Chalk was biogenically deposited in Australia in the warm shallow seas that were created when Australia and India separated from Africa as the great super-continent of Gondwana broke up about 66 million years ago. It is made of calcite ($CaCO_3$) from the shells of tiny marine foraminifera (plankton) called coccolithophores. Chalk is found in the North Perth and Carnarvon Basin sediments. It has a white streak.



Most teachers' chalk in Australia comes from Germany. It is crushed and then reassembled into sticks. The calcium carbonate was laid down at the same time that dinosaurs were alive. They breathed

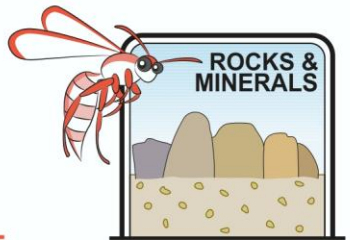
out carbon dioxide which could possibly have been taken in by the coccoliths and converted into calcium carbonate. We might be using fossilised dinosaur breath to use on blackboards! (So much more romantic???)

Spongelite is formed from tiny sponge spicules. These are silica skeletons that support the sponge. When the sponge dies the spicules rain down onto the sea floor and over millions of years become an open network of silica spines despite compaction. Legend has it that the deposit was first recognised by a farmer who urinated on a rock and was astonished to find the fluid was instantly absorbed into the rock. Being curious he then knocked a hole in the outcrop, inserted a stick of fracture (explosive) and stood back to watch. There was just a dull thud and the hole was marginally wider. The spaces between the spines absorbed both the fluid and the explosion. Near Mt Barker north of the Stirling Range a company operates an open cut to mine and sell spongelite for industrial oil spills and cat litter.
Spongelite is mostly greyish white and looks like chalk however it does not release gas when tested with acid.

Limestone can either be produced purely biogenically or chemically. The great Devonian limestone fossil coral reef deposits that make up Cape Range National Park and parts of the Kimberly were formed in warm tropical seas over 360my ago. More commonly the original biogenic deposit has been affected by later chemical solution then re-deposition of minerals.

Tamala limestone

Broken carbonate rich shells were blown inland to form great sand dunes. Ground water initially dissolved away the carbonate but later redeposited it in hollows where roots were. This explains why some areas have both yellow silica sands and carbonate rhizoliths (fossil root shapes).



C. Chemical sediments are formed when inorganic material builds up into a mass.

Evaporites are formed when large masses of water dry up leaving salt (halite), gypsum (hydrated calcium sulphate and anhydrite (calcium sulphate). When evaporates are covered by more sediments and compacted they behave like slabs of soap. They slide upwards to form domes in the overlying sediments. Our salt lakes are accumulating evaporates.

Chemical limestone is deposited from dissolved lime in groundwater or sea water. The coastal limestone of Western Australia was created by shelly dunes being dissolved by groundwater. The lime was later redeposited elsewhere to create sandy (lime poor) sections and hard lime rich areas.
Broken carbonate rich shells were blown inland to form great sand dunes. Ground water initially dissolved away the carbonate but later redeposited it in hollows where roots were. This explains why some areas have both yellow silica sands and carbonate rhizoliths (fossils root shapes).
Limestone is mostly calcium carbonate though some limestones have a magnesium carbonate component also. Slightly acidic groundwater will dissolve the limestone. Cavities will appear when roots that have penetrated the dunes rot away. Water containing dissolved calcium carbonate will follow this route and as it evaporates, calcium will be deposited to eventually fill the space. Since these are not petrified roots they are called rhizoliths (root rocks)