**ACTIVITY: Discovering limestone’s secrets**

**Activity idea**

In this activity, students view the interactive Limestone’s secrets revealed and then answer graded sets of questions based on the content of the video clips from the interactive.

By the end of this activity, students should be able to:

* describe how New Zealand limestones from the Oligocene period have been laid down
* explain the meaning of the term ‘diagenesis’
* recall several of the uses that New Zealand limestone deposits are put to
* describe the reaction of limestone with dilute acid
* have a clearer understanding of geological time scales.

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**Introduction/background**

Limestone is an unusual rock in that it fizzes when dilute acid is placed on its surface.

Limestone is a rock that dominates the landscape in many areas of New Zealand. Limestone is a rock that is quarried for aggregate and building stone as well as being used for making fertiliser, cement, steel and glass. High-purity limestone is used as mineral filler in paper, paint, plastics, rubber and carpet backings as well as in water treatment and as a dusting agent in coal mining to prevent fires. It is literally ‘fizzing’ with uses and applications.

Given its many uses and applications and given its ubiquity in the landscape, this ‘fizzical rock’ deserves closer inspection.

By viewing video clips of an eminent New Zealand geologist on location describing the formation, composition and uses of limestone, students will then answer question sets aimed at improving their knowledge and understanding of this exceptional sedimentary rock that ‘fizzes’ in acid.

**What you need**

* Computer access to [Limestone: secrets revealed](https://www.sciencelearn.org.nz/image_maps/6-limestone-secrets-revealed)
* Copies of the student handout [Finding out about limestone](#limestone)

**What to do**

1. Handout copies of the student handout [Finding out about limestone](#limestone) and have students work through each section of the interactive [Limestone: secrets revealed](https://www.sciencelearn.org.nz/image_maps/6-limestone-secrets-revealed).
2. Have students answer the first set of questions (Basic facts) and discuss.
3. Have students answer the second set of questions (Finding out more) and discuss.

**Student handout: Finding out about limestone**

1. What is the minimum percentage of calcium carbonate needed for a sedimentary rock to classified as limestone?

1. Name any three types of marine invertebrate that contribute to the smashed up shell remains that are associated with certain types of limestone.

1. What is diagenesis?
2. Explain briefly how pressure dissolution results in the eventual cementing together of grains of sediment to make limestone rock.
3. In the McDonald’s limestone quarry, the limestone has a flaggy appearance. What is the reason for this?
4. When a lump of limestone is placed in a beaker and hydrochloric acid is added, the rock is seen to fizz. What is the name of the gas released in this chemical reaction?
5. The geological timescale extends over a time period of 4.6 billion years. It is divided up into eons, eras, periods, epochs and ages. The limestone deposit currently being quarried close to Te Kūiti dates to which epoch?

1. Limestones found in northwest Nelson date to which geologic period?

1. Which tectonic plate event occurred 23 million years ago that has moulded and shaped New Zealand into its current form?

1. Give any three industrial/commercial uses for calcium carbonate obtained from limestone.

***Finding out more***

1. View the ‘Limestone defined’ video clip. In your own words, give an explanation about the conversion, over millions of years, of loose sediment made up of shell fragments into hard limestone rock.
2. View ‘A typical limestone quarry’ video clip. Explain why limestone deposition suddenly ceased near the Oligocene/Miocene boundary.
3. View the ‘Why is limestone an important rock?’ video clip. In your own words, describe how it is used in the agricultural setting.
4. View ‘Oil bearing limestones in NZ’. Describe the key characteristic that has made the Tikorangi Formation an important oil reservoir rock.
5. View the ‘Diagenesis’ video clip. Explain why the seafloor in the vicinity of Three Kings Island is of research interest to New Zealand sedimentary geologists.

**Finding out about limestone answers**

***Basic facts***

1. What is the minimum percentage of calcium carbonate needed for a sedimentary rock to classified as limestone?

*50%*

1. Name any three types of marine invertebrate that contribute to the smashed up shell remains that are associated with certain types of limestone.

*Bryozoans, molluscs, gastropods, echinoderms, brachiopods, worm tubes.*

1. What is diagenesis?

*Diagenesis is the hardening of loose sediment into sedimentary rock. In the case of shelf limestone, it is the skeletal remains of ancient marine invertebrates that form the carbonate sediment.*

1. Explain briefly how pressure dissolution results in the eventual cementing together of grains of sediment to make limestone rock.

*As the carbonate sediment is compacted, grains of calcium carbonate press against one another. This results in the calcium carbonate dissolving into the surrounding pore water. Eventually, this dissolved calcium carbonate precipitates out of solution, cementing the grains of sediment together to form a tight hard rock.*

1. In the McDonald’s limestone quarry, the limestone has a flaggy appearance. What is the reason for this?

*Each ‘flag’ represents a time period of 500 to 1000 years. Thinner less carbonate-pure seams separate the flags. Each flag represents a storm-emplaced sheet of carbonate sediment.*

1. When a lump of limestone is placed in a beaker and hydrochloric acid is added, the rock is seen to fizz. What is the name of the gas released in this chemical reaction?

*Carbon dioxide.*

1. The geological timescale extends over a time period of 4.6 billion years. It is divided up into eons, eras, periods, epochs and ages. The limestone deposit currently being quarried close to Te Kūiti dates to which epoch?

*Oligocene epoch, 23–34 million years ago.*

1. Limestones found in northwest Nelson date to which geologic period?

*Ordovician, 450–500 million years ago.*

1. Which tectonic plate event occurred 23 million years ago that has moulded and shaped New Zealand into its current form?

*The plate boundary between the Pacific plate and the Australian plate came into existence at this time.*

1. Give any three industrial/commercial uses for calcium carbonate obtained from limestone.

*Steel making, glass making, agricultural fertiliser, cement production, tourism, toothpaste, paper manufacture, antacid.*

***Finding out more***

1. View the ‘Limestone defined’ video clip. In your own words, give an explanation about the conversion, over millions of years, of loose sediment made up of shell fragments into hard limestone rock.

*Description to include deposition of skeletal fragments to form the carbonate sediment, compaction of the sediment as it is buried; pressure dissolution kicking in at about 500 metres of burial allowing cementation of the remaining sedimentary material.*

1. View ‘A typical limestone quarry’ video clip. Explain why limestone deposition suddenly ceased near the Oligocene/Miocene boundary.

*The mudstone/limestone boundary noticeable in the MacDonald’s quarry indicates a major geologic event. Environmental conditions changed dramatically from a silt-free water column to one full of silt, mud and sand. It was the continued formation of the plate boundary between the Pacific plate and the Australian plate that was responsible for this major geologic upheaval. The plates pushing together resulted in uplift and fracturing of the landmass. The erosion of these uplands brought mud, silt and sand into the surrounding sea, greatly limiting the dominance of marine invertebrates such as molluscs and bryozoans.*

1. View the ‘Why is limestone an important rock?’ video clip. In your own words, describe how it is used in the agricultural setting.

*Many of New Zealand’s soils are slightly acidic, and this can limit the availability of certain minerals essential for good plant growth. Once the soil’s natural acidic nature is reduced, these ‘locked up’ minerals are released, allowing them to be used by plants. The main mineral in limestone is calcium carbonate, and one of the chemical properties of calcium carbonate is that it readily reacts with acids. If ground up limestone, known as agricultural lime, is spread onto acidic soils, the pH of the soils can be raised due to the reaction of the lime with the acid in the soil. Each year, huge amounts of lime are spread onto New Zealand pasture, allowing it to support an ever-increasing grazing load from sheep and cattle.*

1. View ‘Oil bearing limestones in NZ’. Describe the key characteristic that has made the Tikorangi Formation an important oil reservoir rock.

*The key characteristic that makes this hard, cemented limestone an important reservoir rock is its brittle fractures. It was tectonic compression forces that caused the limestone to fracture giving it ‘fracture porosity’, and it is this that enables the Tikorangi Formation to act as a host rock for hydrocarbons.*

1. View the ‘Diagenesis’ video clip. Explain why the seafloor in the vicinity of Three Kings Island is of research interest to New Zealand sedimentary geologists.

*The shallow seafloor in this region is covered in shelly materials whose composition is exactly the same as that found in Ōtorohanga limestone, which was laid down in the Oligocene epoch 23 million years ago. Eventually, over a time period of millions of years, these loose carbonate sediments will be converted into limestone rock. It is a modern day setting for limestone in the making.*