What might be the marker for the 'golden spike' at the end of the Anthropocene?
How is geological time subdivided and what are likely future human impacts on the Earth?

One of the latest scientific debates is about whether or not a new geological time period should be recognised, called the Anthropocene Epoch. If it is recognised, this would be the time on Earth when human activity dominated the climate and the environment.

To discuss this question, your class would have to:
- first understand how geological time periods are recognised through series of sedimentary strata;
- then discuss what might happen after the time that humans dominate the Earth, which might leave worldwide marker layers.

Geological time from rock records
Geological time has been divided up according to the rock record. Major changes in rock sequences are called marker boundaries and some of these have been used to divide the rock record into systems. An example is the rocks of the Jurassic System which were laid down during the Jurassic Period of time. Systems are subdivided into Series; Periods are similarly subdivided into matching time-periods called Epochs, as below.

Rock sequence	Time sequence	Example
Systems – *divided into:*	Periods – *divided into:*	Jurassic
Series	Epochs	Lower Jurassic

So marker boundaries are used to subdivide rock sequences and therefore geological time. Useful marker boundaries:
- can be recognised by experts, for example where a new fossil appears for the first time;
- are worldwide, so allowing rock sequences in different parts of the Earth to be allocated to the same time period;
- are recorded in different geological environments, so that rocks of different types can be given the same time period;
- are helpful in dividing up geological sequences.

Given these requirements, it is not surprising that nearly all marker boundaries so far have been chosen in deep sea sediments and nearly all are based on the first appearance of certain fossils.

Note that marker boundaries are always chosen at the base of geological time units, meaning that the top of a time unit is marked by the base of the next one. So the question being asked here should really be, '*What might be the marker for the 'golden spike' at the beginning of the Epoch that follows the Anthropocene?*'

When a suitable marker unit has been found, scientists must then find the best example on Earth of the marker. This is designated as a 'Global Boundary Stratotype Section and Point' or GSSP (often called a 'golden spike').

The two photos below show the golden spike for a GSSP in Australia, at the base of the Ediacaran System. This denotes the start of the Ediacaran Period of geological time recognised worldwide (the Ediacaran Period is at the end of the Precambrian time period).

The 'golden spike' of the GSSP at the base of the Ediacaran System; the start of the Ediacaran Period.

An enlarged photo of the Ediacaran 'Golden spike'.

An Anthropocene 'golden spike'?
There are strong views amongst geoscientists about whether or not the Anthropocene should be formally recognised. Some of the reasons for this are outlined in the 'context' section below. If the Anthropocene does become approved, then suggestions for 'golden spike' markers for the start of the Anthropocene have included:
- the first appearance of plastics in deep sea sediments, from the 1950s onward;
- radiation from the first nuclear explosions in 1945.

So, what might be the marker for the 'golden spike' at the beginning of the Epoch that follows the Anthropocene?'
We will never know the answer to this question, but the best discussion and answer will be based on the best understanding of how stratigraphy works, and the best ideas about 'Future Earth'.

The back up

Title: What might be the marker for the 'golden spike' at the end of the Anthropocene?

Subtitle: How is geological time subdivided and what are likely future human impacts on the Earth?

Topic: A class discussion focussed on how geological time periods are devised and what the future for the Earth might be.

Age range of pupils: 14 years and older

Time needed to complete activity: 10 minutes

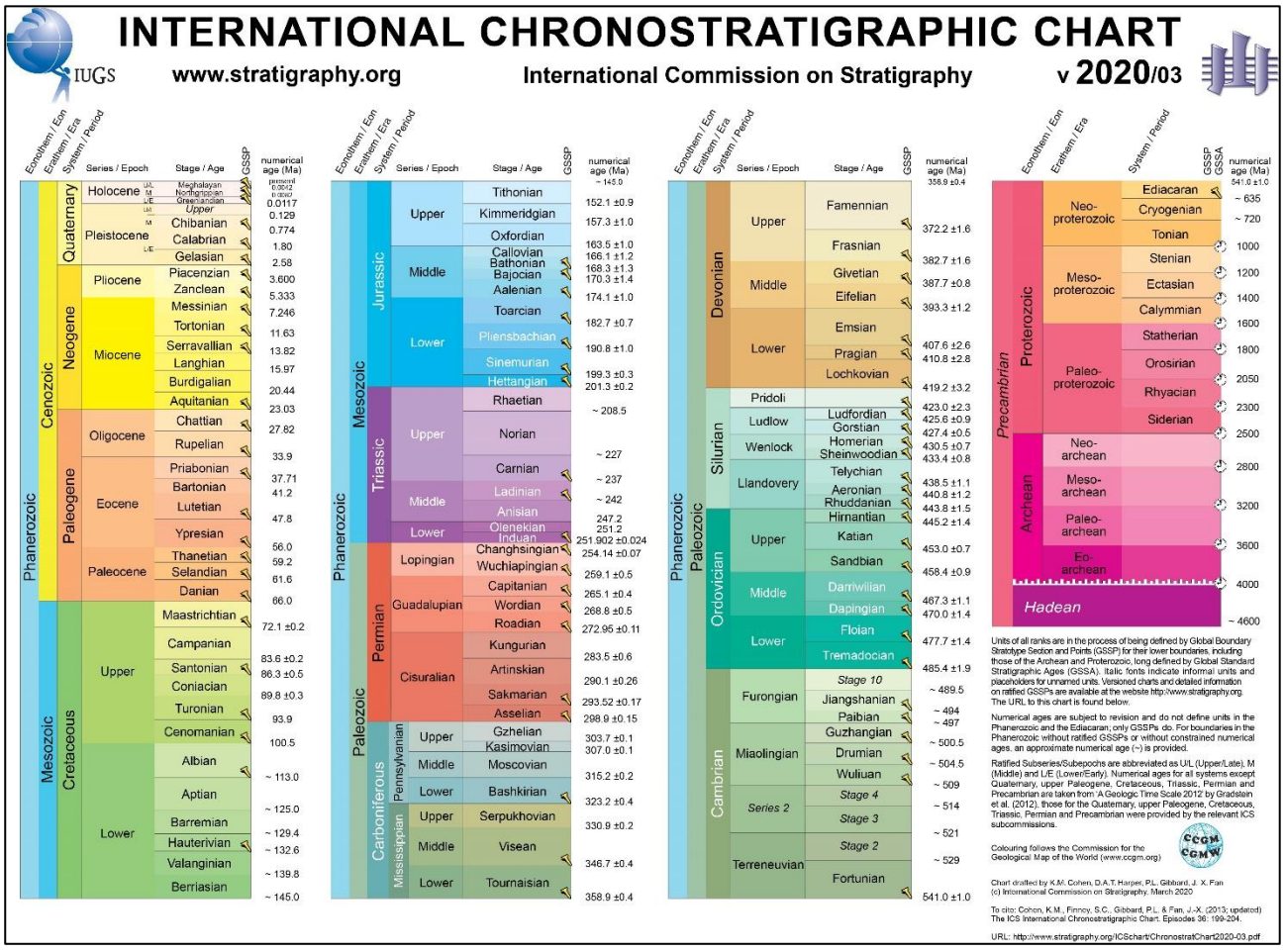
Pupil learning outcomes: Pupils can:

- describe how rocks sequences are divided by marker boundaries into, for example, Systems and Series;
- describe how these rock sequences are used to divide geological time into, for example, Periods and Epochs;
- explain how human activities are currently having a geological influence on the Earth;
- explain possible future scenarios for the Earth's development.

Context:

The history of the Earth and thus the time units of that history has been pieced together from sedimentary rock sequences on all continents. Major sections were given names such as Jurassic and Cretaceous and these were later shown to succeed one another in time.

The subdivision of rocks and of geological time is shown in the International Chronostratigraphic chart published by the International Union of Geological Sciences' International Commission on Stratigraphy. The proposal for each section of rocks and of time has been scrutinised by the Commission and a marker for when that sequence/time began has been agreed. Wherever possible, a geological sequence which best shows the beginning of that section of time has been identified, and the 'marker' horizon has been highlighted with a 'golden spike'. The full chart is shown below (from: http://www.stratigraphy.org/index.php/ics-chart-timescale). This symbol on the chart shows where 'golden spikes have been identified: .



Most of the marker horizons in the chronostratigraphic chart are marked by the first appearance of a fossil species. The best fossil species to use as markers are those that appear in the geological record suddenly over a wide geographical area, and can readily be identified by experts. The dates for marker horizons are based on radiometric dating, often of volcanic ash horizons (volcanic ash often contains minerals which can be radiometrically dated, whilst most sediments and fossils do not). The only GSSP not in deep sea sediment is the one at the base of the latest epoch of geological time, the Holocene, which is recorded in ice cores.

The Anthropocene is a proposed Epoch at the end of the Quaternary Period. The name 'Anthropocene' is made up from '*Anthropo*' or 'human' and '*-cene*' meaning 'new' or 'recent' in Ancient Greek.

Currently the International Commission is considering the evidence for the Anthropocene together with where the Anthropocene GSSP might be placed.

In order to be recognised, the Anthropocene must be a geological sequence or stratigraphic unit with a recognisable base and must overlie areas of older rock. It cannot be based on material based on our own human timescale, but must use the same evidence as used for other units in the chart.

So far, these requirements have not been met, which is why the Anthropocene has not been recognised. However, if the Anthropocene is eventually not recognised, the name is likely to continue as an informal term.

Following up the activity:
Ask the class how a geological time scale might have been constructed for Mars by referring to a map of the geology of Mars found on the internet, for example at: https://astrogeology.usgs.gov/search/map/Mars/Geology/Mars15MGeologicGISRenovation.

The answer is that the sequencing on Mars was done using the stratigraphic principles described in the 'Laying down the principles' Earthlearningidea at: https://www.earthlearningidea.com/PDF/Laying_down_the_principles.pdf

Underlying principles:

- Rock sequences are divided up by marker beds and these sequences are called, for example, Systems and Series.
- The times during which rock Systems were deposited are called Periods whilst the times during which rock Series were deposited are called Epochs;
- Rock sequence marker beds can be recognised by experts, often through the first appearance of a fossil species.
- The detailed subdivisions of geological time have been determined by the scientists of the IUGS International Commission on Stratigraphy – their work is updated regularly.
- A new latest period of geological time has been proposed, called the Anthropocene Epoch – this proposal is currently being considered by the International Commission.

Thinking skill development:
Imagination and lateral thinking are needed to imagine how the planet with its current human influence might develop and what events might provide markers for a new geological time period.

Resource list:

- a vivid imagination

Useful links:
Given above.

Source: Chris King of the Earthlearningidea Team. Scientific expertise was provided by Stan Finney, Secretary General of the International Union of Geological Sciences – to whom, many thanks.

The IUGS International Chronostratigraphic Chart is used with permission – www.stratigraphy.org