Society Update

Climate Change Statement

The Executive Committee of the GSA has produced the following draft Climate Change Statement after a prolonged period of consultation with GSA members. In line with feedback from members, the statement emphasises the geological record as an archive of past climate change and how it can contribute to our understanding of future climate change.

The Executive Committee recommends that the statement be adopted by the Society, but welcomes further member feedback no later than 31 January 2013. This will be followed by consultation with Divisional and Branch committees during February 2013, after which a final statement will be endorsed by the GSA Executive and placed on the GSA website. All comments should be emailed to ***climatechange@gsa.org.au.***

Draft GSA Climate Change Statement

The Geological Society of Australia (GSA) has developed this document as a science-based statement regarding climate change,[1] emphasising the contributions that Earth Science can make to the public discussion. This Statement provides the views of a learned Society dedicated to investigation in Earth Sciences and is made by the Executive Committee of the GSA, after wide consultation with Society Members who are qualified Earth Scientists largely working in or retired from academic, industry, government and public sector organisations.

The nature of the geological record

Instrumental records of global climate are short when it comes to estimating future climate changes because many of the processes that control global climate operate on very long time scales by human standards. Current debate about the causes and consequences of global climate change can be informed by studying the geological record of past climate changes on time scales from decades to billions of years.

The geological record provides the key source of information regarding Earth's past climates, including periods when global climate was both significantly warmer and colder than the present. Important climatic archives include sediment cores from the oceans (up to tens of millions of years old), ice cores from Greenland and Antarctica (up to 800 000 years old), as well as marine and continental sedimentary rocks that may be hundreds of millions of years old. Evidence may include the distribution of fossil plants and animals, the past distribution of ice on the Earth's surface, and estimates of temperature and atmospheric composition based on geochemical measurements, to name just a few examples. In some cases, the geological record may be very detailed and young enough to overlap with instrumental records of climate (eg, annual growth layers in corals).

Variability of past climates

Geological evidence clearly demonstrates that Earth's climate system is inherently and naturally variable over time scales from decades to millions of years.[2]

Some 50 million years ago, mean global temperature was about 6°C warmer than today. Since then, Earth's climate has fluctuated but has been generally cooling as large ice sheets formed, first in Antarctica and then in the Northern Hemisphere. Over much of the last 2–3 million years the climate has typically been colder than today, often much colder, when the growth of ice sheets during 'glacial periods' caused sea levels to be more than 120 m lower during the largest glacial advances. These glacial periods have been interspersed with intervals of warmer climate, referred to as interglacial periods. The Earth is currently in an interglacial period, called the Holocene Epoch. There have been some 50 glacial/interglacial cycles during the last 2.6 million years. The present glacial/interglacial cycle began some 115 000 years ago with a major global cooling event and growth of ice sheets progressively extending from the polar ice-caps to lower altitudes/latitudes. This glacial period peaked about 20 000 years ago, when global temperature was some 5°C colder than today, and was then followed by progressive warming, ice melting and sea-level rise that led to the present interglacial. We know also that during the last 15 000 years interruptions to the gradual warming occurred, with both rapid cooling and warming episodes sometimes occurring over time periods as short as a few decades.

Causes of past climate changes

Earth's climate is sensitive to a variety of factors including:

1. Planetary-scale controls such as solar and orbital variability and large impact events.

2. Tectonics and plate movements, including large volcanic eruptions, which have major long-term influences on weathering, erosion, surface temperatures and ocean/atmosphere circulation.

3. Earth-specific factors such as biological feedbacks, surface albedo and atmospheric composition, including dust and other particulates. Human activities may impact on these Earth-specific factors to cause anthropogenic climate changes, both locally and globally.

Climate sensitivity

A detailed, scientific understanding of the climate history of the Earth, based on the geological record, is essential to appreciate and quantitatively unravel the various sensitivities contributing to climate variations both short-term and long-term. The term 'climate sensitivity' is used to describe the change in globally averaged temperature that is caused by a given amount of climate forcing. For example, the sensitivity of global climate to variations in Earth's orbital parameters (axial tilt, orbital eccentricity and precession) is known to be around 5 to 6°C during glacial/interglacial cycles of the past 2–3 million years. However, orbital forcing alone cannot account for this magnitude of sensitivity — there are complex feedback mechanisms that amplify the orbital forcing, some of which are reasonably well understood and some of which require further research and testing to be well understood.

Future climate

The geological record clearly shows that the Earth's climate will change from what it is today. The critical question, however, is the direction, rate and scale of change and consequent environmental effects on essential human activities such as agriculture and settlement patterns. Geological archives of past climate changes merit careful study to better understand Earth's complex climate system, including the primary controls and feedback mechanisms that cause these changes.

Regardless of whether climate change is from natural or anthropogenic causes, or a combination of both, human societies would benefit from knowing what to expect in the future and to plan how best to respond. Just as we now attempt to prepare for intense, but short-lived disasters such as earthquakes, tsunamis, landslides and volcanic eruptions, so preparations should be made for other variables such as climate change that may have more widespread and longer term effects. The GSA makes no predictions or public policy recommendations for action on climate beyond the generally agreed need for prudent preparations in response to potential hazards, including climate change.

Scientific approach

Science seeks to explain natural phenomena using natural laws, verifiable and reproducible observations and logical analysis; it reaches explanations that are always subject to amendment with new evidence. Our understanding of the geological record of past climate change should be based on the best available peer-reviewed science. The GSA encourages those interested in following the debate on climate science to attach greatest credence to the communications of those scientists commenting within their fields of expertise, as defined by their peer-reviewed publication record.

BRAD PILLANS
Past President, GSA
26 October 2012

FOOTNOTES

[1]The term 'climate change' is used throughout this document to refer to all climate changes, whether natural or anthropogenic, regardless of cause.

[2]An excellent review paper is Zachos *et al* 2001. Trends, rhythms, and aberrations in global climate 65 Ma to present. *Science* 292: 686–693.

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