Awards Ceremony 2014 – senior medallists' talks

Lyell Medal (Martin Brasier – Professor of Palaeobiology, University of Oxford)
In search of the earliest life on Earth
How good is the earliest fossil record? And how can we best examine it? These questions matter because of the vast duration of Precambrian time (c. 4550 – 541 Ma), which spans nearly ninety percent of Earth history and contains most of the 'major evolutionary transformations' in the history of life. There is therefore a pressing need for reliable pre-trilobite fossil remains to help decode the emergence of complex life in terms of pattern, rate and process. There is an equally pressing need to convey the story and excitement of this research to a wider audience.

Much of what we have learned about this interval has emerged during my lifetime. Progress has demanded new definitions and new protocols, involving debates about the earliest fossils to characterisations of the Cryogenian, Ediacaran and the Precambrian-Cambrian boundary intervals. In this talk, I will show how an expanding range of habitats (e.g., lakes) and new 3D microtaphonomy (e.g., synchrotron, FIB-TEM) may change our thinking about early life. Reference will be made to ongoing results from keystone fossil deposits, such as Apex (3360 Ma), Strelley (3430 Ma) and Gunflint (1880 Ma), and to the emerging evolutionary significance of our Torridonian (1200-1000 Ma) and Charnwood (560Ma) fossils.

Murchison Medal (Julian Pearce – Professor Emeritus, School of Earth & Ocean Sciences, Cardiff University)
Geochemical fingerprinting of rocks and minerals
Geochemical fingerprinting is a methodology for interpreting the geological and tectonic setting of formation of past igneous and sedimentary rocks, using either immobile element and isotope ratios of the rocks themselves or the full compositions of alteration-resistant minerals within those rocks. The results can be used in making geological reconstructions and in addressing a range of geological problems. One topical project is to trace the subduction history of the Earth. Currently, this is controversial with some holding the view that subduction (and hence plate tectonics) operated throughout geological history, others believing that subduction in its present form did not begin until at least the end of the Archaean, and others favouring stop-start subduction for much of the Earth's early history. New trace element projections make it possible to recognise two types of basalt-andesite-dacite-rhyolite sequence in the Archean: one formed by interaction of plume magmas with continental crust, and the other by subduction-like processes. The challenge is now to determine whether the latter is the type of subduction prevalent at the present-day, which requires plate tectonic processes, or whether it represents a non-uniformitarian way of translating crustal rocks into the mantle more consistent with a stagnant lid early Earth.

William Smith Medal (Peter Styles – Professor of Applied & Environmental Geophysics, Keele University)

A journey with maps

When I set out (probably with a map as I was that kind of boy!) from Alnwick in Northumberland 45 years ago to study for a degree in physics at Oxford - itself a daunting prospect for a callow youth - I never imagined that I would end up standing here in the Geological Society of London, having been Secretary and President and now receiving the William Smith Medal for contributions to Applied Geoscience.

It is a testimony to two things principally: first my inability to resist following the lure of researching into and teaching things which inspired my interest which led me down the geophysical and then the geological primrose paths but perhaps more importantly the incredible way in which the Geological Society is able to embrace, take to its bosom and make its own, those who might not at first glance be a 'good fit'.

Those who know a little about history might know that it was not always so, as that erstwhile William Smith was seen as not only an outsider but also rather infra-dig as a common man and a surveyor to boot, and booted he certainly was and rather ruthlessly plagiarised and his map copied by Greenough. Now, of course, both maps hang side by side outside this lecture theatre and one of the other medals, the Wollaston, was struck in Palladium to honour him.

I have always been inspired by the journey, both literal and metaphorical, which William Smith made to complete his map and so am honoured and eternally grateful to the Geological Society for adopting me and for this award.

Wollaston Medal (Maureen Raymo – Lamont Research Professor, Lamont-Doherty Earth Observatory, Columbia University)

The Pliocene Sea Level Paradox

The amount of polar ice melt, and thus sea level rise, during the mid Pliocene warm period has been a subject of great interest for decades. Global climate during this time appears to have been ~2-3°C warmer than today with atmospheric CO_2 values between 350-450 ppm. Yet despite decades of study, the maximum sea level rise during this time period remains uncertain with estimates ranging from 5 to >35 meters above present. Why such variability? Researchers have focused study of past sea level on stable passive margins, believing these regions would preserve sea level indicators with minimal post-depositional movement. However, we have shown that glacial isostatic adjustment can significantly influence the elevation of ancient shorelines far from polar regions and derived a methodology for correcting Pliocene sea level observations for time-varying deformation of the solid Earth caused by ice sheet loading. We have also shown that dynamic topography (elevation changes caused by the force exerted on the lower crust by the buoyant upper mantle) can also cause tens of meters of surface uplift, in areas far from any active tectonic plate boundary, on timescales as short as a few million years. Ultimately, a much larger matrix of global shoreline observations from the Pliocene will be needed before any confident estimate of eustasy (ice volume) at that time can be made. The largest source of error currently is uncertainty in the geographically-variable amplitude and time history of dynamic topography.