Are there four cycles of extreme climate change in the Neoproterozoic Dalradian Supergroup of Scotland and Ireland?

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The Dalradian supergroup was deposited on the SE margin of Laurentia between 800 and 500 Ma. An early phase of terrestrial arkosic sedimentation gave way to shallow and then deeper water sediments including limestones and shales. These rock types form distinctive couplets, those with less than 0.2 wt % TOC are represented by 3 periods of cream to pale-grey carbonates and phyllites, those with >0.2 wt % TOC by 4 periods of dark grey limestone and black shale deposition.

The dark limestones have characteristic $\delta^{13}C$ of +2 to +9 ‰ and abundant pyrite with $\delta^{34}S$ of +5 to +20 ‰. The pale carbonates have $\delta^{13}C$ between -12 and +3 ‰ and are mostly sulphide poor, but within each there are periods of abundant sulphide, associated with -9 to -5 ‰ carbonates. Their $\delta^{34}S$ values are very variable (-15 to +50 ‰) suggesting rapid changes in ocean chemistry. The best example has $\delta^{34}S$ increasing by 15 ‰ as $\delta^{13}C$ carbonate changes from -9 to -4 ‰, a trend best explained by methane emission using up the local ocean sulphate reservoir as it is oxidized, forming carbonate, and sulphide as a bi-product.

Correlation of these cycles with age constraints, glacial evidence and previous isotopic studies (e.g. [2, 3]), allow them to be placed into global context. Extreme ^{34}S-enrichment is a characteristic of sulphides in post-Sturtian sediments, and the first prolongued ^{34}S-depletion, a characteristic of post-Marinoan sulphides due to increased oxygen and therefore sulphate levels [1], providing constraints on the relative ages of the observed chemostratigrahic trends.

The first cycle contains the pale Appin Limestone, with -7 ‰ carbonates at the base and an abundant pyrite interval. It pre-dates the purported Sturtian (720-705 Ma) glacial period (e.g. [2, 3]) that contains the Port Askaig Tillite (part of the 2nd cycle). It could be an earlier Sturtian event, but might also relate to the 740 Ma Kaigas glaciation identified in Southern Africa and Ethiopia, given the possibility that Dalradian sedimentation commenced 60 Ma earlier than this. The 3rd cycle is thought to be Marinoan in age and the 4th, with 600 Ma volcanics, contains Gaskiers equivalent glacial deposits (McKay *et al*., 2006).

[1] Hurtgen *et al*. (2005) *Geology* **33**, 41-44. [2] Lowry *et al*. (2008) *GCA*. **72** (12) Supplement 1, A569. [3] McCay *et al*. (2006) *Geology* **34**, 909-912.

CEINT and iCEINT: An international collaboration to assess the environmental implications of nanotechnology

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The potential effects of manufactured nanomaterials on human health and the environment remain largely unknown. The staggering permutations of nanomaterials and surface functional groups, and variability in environmental conditions at the points of release of manufactured nanomaterials, makes predicting their impact on ecosystems challenging. The Center for Environmental Implications of Nanotechnology (CEINT), a NSF and EPA funded Center headquartered at Duke University, and the international Center for Environmental Implications of Nanotechnology (iCEINT), headquartered at CEREGE Centre Européen de Recherche et d'Enseignement des Géosciences de 'Environnement, conduct research aimed at elucidating the vast array of nanomaterial properties to their potential environmental and human health impacts. This collaboration is centered on student and faculty visits between the groups and coordinated use of facilities available to them.

The collaborative effort will develop the information required for ecological risk assessments of nanomaterials. Research priorities are to 1) determine the quantities and form of nanomaterials released into the environment, 2) determine the fundamental abiotic and biotic processes affecting fate, transport, and transformation of released nanomaterials, and 3) identify nanoparticle properties that affect their persistence, bioavailability, uptake, and effects on biota and ecosystem function. Metals (e.g. Ag), metal oxides (e.g. CeO_2), and carbon nanomaterials are evaluated. The role of engineered and acquired surface coatings on these processes is also determined.