Paper Number: 4991

Early diversification of the Cambrian Explosion: Significance of a remote graveyard in the Sirius Pass, North Greenland

Harper, D.A.T.[1], Hammarlund, E.U.[2] and Smith, M.P.[3]

[1] Palaeoecosystems Group, Department of Earth Sciences, Durham University, Durham, UK, david.harper@durham.ac.uk
[2]Nordic Center for Earth Evolution (NordCEE), Department of Biology, Syddansk Universitet, Odense, Denmark
[3]Oxford University Museum of Natural History, Oxford, UK

Early Cambrian Lagerstätten provide critical evidence for the initial construction of animal-based communities, the early diversification and relationships of the metazoans, and the environmental constraints on the appearance of modern ecosystems. The Sirius Passet fossil biota is the most remote and least well known of all the Cambrian Lagerstätten. Following its serendipitous discovery in 1984 by the Geological Survey of Greenland, the locality in the Buen Formation, Peary Land, North Greenland, has been visited a number of times, most recently in 2009 and 2011 by multidisciplinary and multinational groups, led by the Natural History Museum of Denmark. The Sirius Passet Lagerstätte occurs in black slates deposited at or just below storm wave base, deposited by low-density sediment gravity flows. The very abundant trilobite *Buenellus higginsi* correlates the Sirius Passet succession with the *Nevadella* Zone in Laurentia, equating with Cambrian Stage 3 or c. 516.5-519 Ma and contemporary with or possibly older than the Chengjiang Lagerstätte from the Yangtze platform in South China. It thus represents the earliest Cambrian microbial mat community with exceptional preservation, predating the Burgess Shale by some 10 million years.

The Sirius Passet fauna is broadly similar to that of the Burgess Shale, but to date only comprises ca. 50 species including trilobites, sponges, worms, halkieriids, lobopods, and non-trilobite bivalved arthropods. Rarefaction analyses indicate considerable potential to increase its diversity. The fauna is one of the earliest examples of high-fidelity, soft-tissue preservation in the Cambrian. The fauna exhibits some unusual taphonomic pathways that may provide a new window on the environment and location of the Cambrian Explosion. This window closed with the appearance of abundant mat grazers later as the Cambrian Explosion intensified.

Geochemical clues of early Cambrian oceanic conditions primarily stem from sections on the Yangtze platform, suggesting a low-oxygen ocean with possibly oxygen minimum conditions. Analysis of the geochemistry at Sirius Passet, evaluated with due consideration of any diagenetic overprint, suggests a water column with low oxygen, but not anoxia. This additional information from Sirius Passet significantly extends the geographic spread of our understanding of ocean chemistry at this critical time. The chemical data, in addition to palaeontological and sedimentological evidence, suggests that the Sirius Passet biota lived just above the chemocline and, possibly, in low-oxygen conditions.

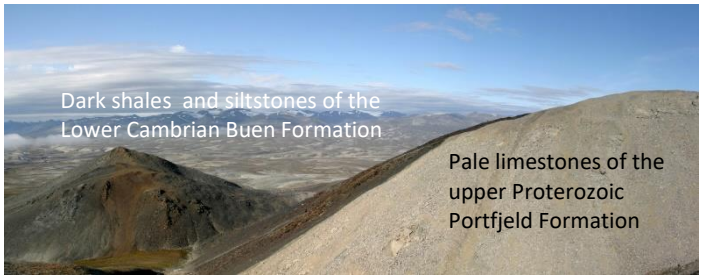

Figure 1: Geological section through the upper Proterozoic – Lower Cambrian succession in the Sirius Pass region. Locality directly below the word 'Formation' on the left of the photograph.

Example.....