Geophysical Research Abstracts, Vol. 9, 07435, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07435

Climate belt reorganization, coastal upwelling, carbon sequestration and global climate change in the late Ordovician: a case study from the Welsh Basin, U.K.

T. Challands (1), H. Armstrong (1), J. Davies (2), D. Wilson (2), A. Owen (3), M. Williams (4)

(1) Department of Earth Sciences, Palaeozoic Environments Group, Durham University, South Road, Durham, UK, DH1 3LE, (2) British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham, UK, NG12 5GG, (3) Department of Geographical and Earth Sciences, University of Glasgow, Gregory Building, Lilybank Gardens, Glasgow, UK, G12 8QQ, (4)University of Leicester, Department of Geology, University Road, Leicester, UK, LE1 7R (t.j.challands@durham.ac.uk / Fax: +44 0191 3342301 / Phone: +44 0191 3342300)

Changes in atmosphere – ocean dynamics and associated enhanced coastal upwelling in low to mid-latitude basins can lead to the widespread deposition of organic-rich sediments and potentially provide a mechanism for drawdown of atmospheric CO_2 and global cooling. The late Ordovician was characterised by one of the major Phanerozoic glaciations and provides a test case.

Elsewhere it has been shown that during the Boda Warm Event (BWE), immediately prior to the glacial maximum, a southerly shift in latitudinal climate belts, including the position of the Sub-Tropical High Pressure Belt, resulted in stronger SE trade winds and induced Eckmann transport. This model predicts enhanced coastal upwelling along SW-NE trending coastlines in mid-palaeolatitudes and the development of anoxic conditions in restricted ocean margin basins.

The Welsh Basin lay at $\sim$25-30^{o}S during the BWE, on the southern margin of the Iapetus Ocean. Anchizone grade mudrocks of the *anceps* graptolite Biozone record four cycles of oxic organic-poor to anoxic organic-rich laminated hemipelagite (6-30m thick) that can be correlated across the Iapetus Ocean and with C-isotope excursions in tropical carbonates. The anoxic horizons exhibit negative $\delta^{13}C_{org}$ excursions and high total organic carbon (TOC), indicative of increased productivity. Invariance of

run-off proxies (K/Al, Ti/Al) with TOC through the anoxic events, support enhanced coastal upwelling as the primary mechanism of anoxia.

We support the hypothesis that enhanced coastal upwelling, linked to a reorganization of Upper Ordovician climate belts, was responsible for the deposition of thick, organic-rich black shales in mid-latitude settings during the BWE immediately prior to the Hirnantian glacial maximum. Development of anoxia was cyclic, reflecting the changing strength of the SE trade winds, coastal upwelling and productivity. Accelerated marine productivity and sequestration of carbon contributed to and likely accelerated drawdown of atmospheric CO_2 beyond a threshold whereby the global climate entered a glacial maximum state. During the onset of glacial maximum, SE trade winds decreased in strength at mid-latitudes as the climate belt system reverted back to a 'cool' northerly position. Upwelling ceased at mid-latitudes and carbon sequestration rate decreased creating a positive feedback towards warming preventing global climate from entering a deeper ice-house condition.