Geophysical Research Abstracts,
Vol. 11, EGU2009-12163-1, 2009
EGU General Assembly 2009

Near coast sedimentary stratigraphy as a proxy for climatic instability

J. Mclivenny
(jason.mcilveny@thurso.uhi.ac.uk)

Several studies have indicated a link between climatic deterioration and dune stability (Wilson 2002, Issar 2003, Dawson et al 2004). The frequency and magnitude of storms have been cited as a key variable in the stability of large dune systems. For the stratigraphy of dune systems to act as a regional climatic proxy there must be a good regional relationship between known climatic events and regionally correlated stratigraphic changes.

Dunnet Bay in Caithness, Northern Scotland was chosen as a study site to look at the relationship between dune stability and climatic change during the late Holocene in Northern Scotland. Dunnet Bay was chosen for its physical attributes which make it an excellent natural sediment trap. Tucked in between headlands which act as barriers to long-shore transport the predominant movement of sediment there is straight onshore, with only minor amounts being lost to the sea.

The immediate back-dune stratigraphy, colloquially known as “links”, provided evidence of peat formation and dune stability. Stratigraphy was mapped using traditional field techniques and ground penetrating radar. The cores consisted mostly of massive layers of sand interleaved with peat. Sand layers were dated with optically stimulated luminescence (OSL) and interpreted as reflecting high wind energy regimes transporting sand inland. Peat layers were C14 dated and taken as representing climatic stability.

Stratigraphy was mapped using hand auguring, percussion coring, and open sections. Ground penetrating radar was also used to look at the continuity of key layers. OSL dating in two open sections showed dates obtained from the first section (1790 AD $\pm$70, 53 BC $\pm$ 100, 300 BC $\pm$ 100, 400 BC $\pm$ 100) mapped to the top of the second section (1800 AD $\pm$ 100, 1500 BC $\pm$ 200, 2900 BC $\pm$ 300) which was consistent with stratigraphy increasing sediment thickness towards the centre of the bay. The results were consistent with acquired C14 dates from selected peat layers. Taken collectively the results are consistent with some known episodes of climatic instability which occurred during the mid Holocene with instability phases occurring in Dunnet from approximately 6300– 4250 yrs BP, associated with climatic deterioration between 6000 – 5,200 Yrs BP (Lamb 1995) and dune instability between 2560 – 3900 Yrs BP, associated with an abrupt change of climate (Anderson 1995)

In addition to the luminescence dates, 31 luminescence profiling dates were acquired in order to look at the continuity of the age vs. depth profile. Luminescence profile dates are small samples that require less preparation prior to luminescence measurement than full luminescence dating. Although larger errors are associated with luminescence profiling, it offered means of identifying at lesser cost the possible occurrence of mixing between eroded layers.

The stratigraphic chronology was compared to other local and regional dune studies and periods of climatic deterioration found in other proxies. The GISP2 ice core (Greenland Ice Sheet Project) was found to provide chemical proxies for North Atlantic storminess which partially explained our observed stratigraphy (O‘brien et al 1995). It is concluded that changes in dune stability at a regional scale are also influenced by local variables, so that one should be careful when attempting to draw stratigraphy to climate change.
Key References:

Issar, A. (2003) Climate changes during the Holocene and their impact on hydrological systems. Published

by the Cambridge University Press 2003.

Wilson, P. (2002) Holocene coastal dune development on the South Erridale peninsula, Wester Ross, Scotland. Scottish Journal of Geology, 38, 1, 5-13.

Dawson, S., smith, D., Jordan, J., and Dawson D. G. (2004) Late Holocene coastal sand movements in the outer Hebrides N. W. Scotland. Marine Geology 210, 281-306

O'Brien, S. M. Mayewski, P.A. Meeker, L. D., Meese, D. A., Twickler, M. S. & Whitlow, S. I. (1995) Complexity of the Holocene Climate as reconstructed from a Greenland ice core. Science 270, pp 1962-1964

Lamb, H. (1995) Climate, History and the Modern World. Published by Routledge ISBN 0415127343, 9780415127349 2nd ed.

Anderson, D. E. (1995) An abrupt mid-Holocene decline of pinus sylvestris in Glen Torridon, north west Scotland: Implications for paleoclimatic change. School of Geography and the Environment Research papers, Oxford