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An overview of the recent palaeolimnology of selected lakes in the Romanian Carpathians

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Lake sediments can act as sensitive monitors of environmental change and human impacts. The Romanian Carpathians hold a significant number of glacial lakes and transverse a region of considerable environmental concerns, but relatively sparse environmental data and little recent lake sediment based research. Findings from selected lakes in two of the highest sections of these mountains in Romania are presented. In addition the palaeolimnological record held in the surficial sediments of other lower elevations sites in the Eastern Carpathians is also discussed. These sites are situated in contrasting sites comprising a volcanic crater lake (Lacul Sfânta Ana, Harghita Mountains) and a lake dammed by land sliding (Lacul Iezer-Feredeu, Obcina Feredeului).

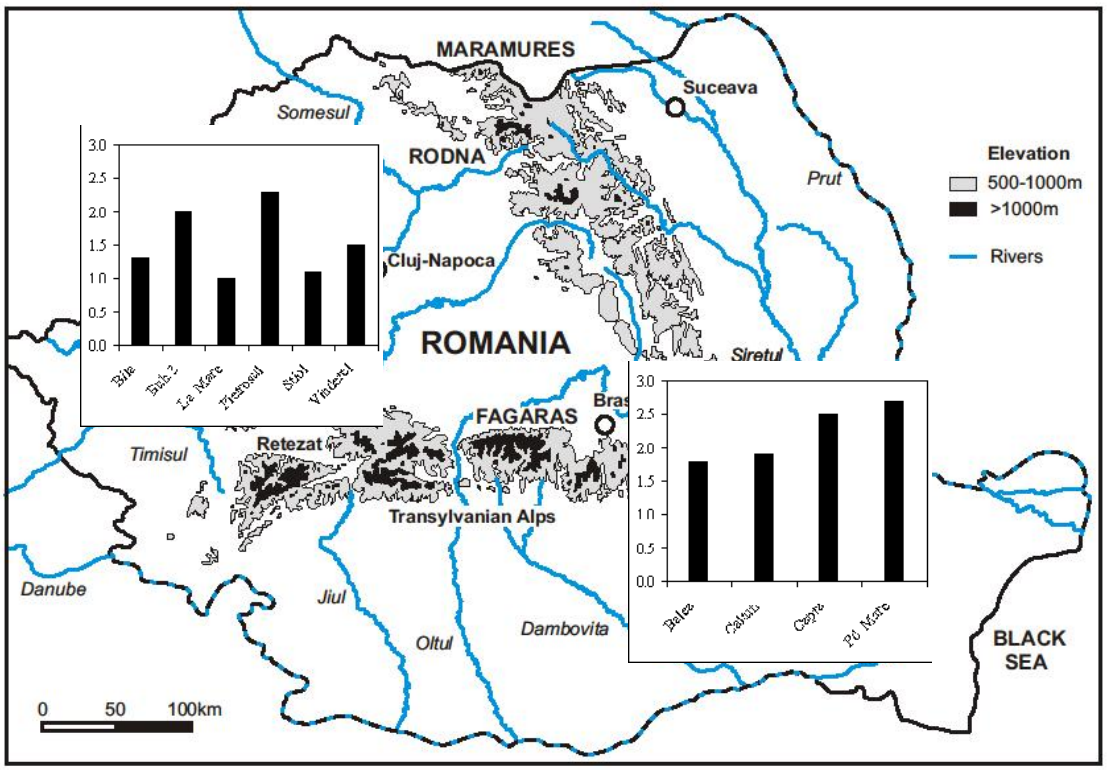

Figure 1. Pb enrichment factors at sites in the northern (top left insert) and southern study areas (bottom left insert).

Glacial lakes in the Rodna, Maramures and Făgăraş Mountains. Surficial lake sediment cores from ten mountain lakes have been characterised in terms of their mineral magnetic and geochemical properties, providing an initial, country-wide assessment of the potential of these mountain lakes' sediment records as a retrospective monitor of atmospheric pollution. The mineral magnetic characteristics suggests that recent sediments have been affected by atmospheric particulate pollution associated with fossil fuel combustion and vehicle emissions, although the properties may also reflect within lake processes. Metal enrichment factors for contemporary sediments also reveal that remote mountain lakes in this region appear to have been impacted by the long-range atmospheric transport of metallic pollutants. Furthermore, the results of geochemical analysis (via ICP-OES) suggest that sites in the Southern Carpathians are most impacted, although trace metal levels are relatively modest. This pattern is illustrated in Figure 1 in the case of Pb enrichment. At a key site (Lacul Capra, Făgăraş Mountains) a core has also been ^{210}Pb dated and SCP analysis undertaken providing a more detailed chronology. Whereas some of the lakes studied may ultimately be suboptimal as sites for recent palaeoenvironmental reconstruction due to the apparent post depositional disturbance of their sediments, initial findings suggest that others may have the potential to provide lake sediment-based pollution histories that will thereby contribute to a fuller, Europe-wide understanding of the impact of atmospheric pollutants in upland regions.

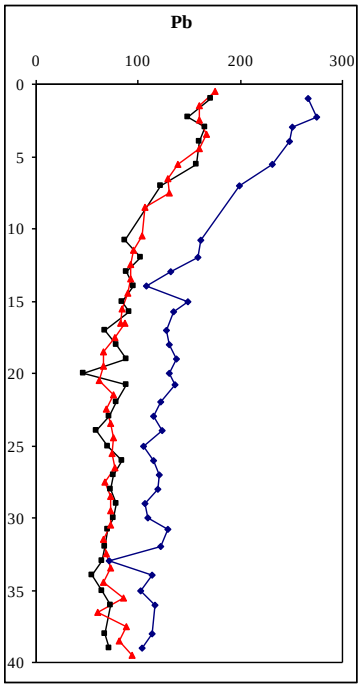

Figure 2. Down core Pb profiles from Lacul Sfânta Ana. (Key; 2007 core determined by pXRF (blue line) and ICP-OES (black line). 2010 core via pXRF (red line) (Units: mg kg-1)).

A recent environmental record from Lacul Sfânta Ana. At Sfânta Ana in the Harghita Mountains recent sediment profiles of their magnetic properties and trace metal characteristics appear to provide a relatively unperturbed record of an atmospheric input of contaminants related to human impacts such as industrial activity and vehicle emissions. However, recent human impacts within the catchment may also have impacted upon this signal. The geomorphology of the site (a volcanic crater lake with no significant inflow and no surface discharge points) suggests that this site should provide optimal conditions for sediment - based environmental reconstruction. However, the surface sediments at this site have a relatively low density making sampling near the sediment - water interface problematic. Nevertheless, cores taken in 2007 and 2010 can be correlated via their trace metal profiles (using pXRF and ICP-OES) providing confidence as to the veracity of their record of recent sedimentary inputs (see Figure 2). These preliminary data may also contribute to the environmental management of this popular and significant site suggesting the merit of further investigation.

Lacul Iezer-Feredeu - a landslide dammed lake. A range of historical evidence is available that indicates that Lacul Iezer-Feredeu (Obcina Feredeului, Eastern Carpathians) may be the oldest water body formed by a land slide dam in Romania. The lake may be over 400 years

old. Coring from ice with a Russian - type corer its sediments have been found to be highly banded throughout a profile of over 4m in length. Preliminary analysis (organic content, particle size, mineral magnetic properties and geochemistry (pXRF based)), suggests that these laminations predominantly reflect changes in sediment particle size. The sediments also provide further evidence of lake level and catchment input changes during the lifetime of the lake. However, the environmental archive held by these deposits is currently limited by the lack of a chronology.

Summary. This paper illustrates some of the findings of a period of collaborative research that has focussed on the potential for environmental reconstruction (in particular of recent human impacts) held within the recent sediments of a range of lacustrine environments. Whereas there is a long tradition of palaeoecological study within the region, the Carpathian Mountains in Romania have been identified as a region where there is a relative paucity of (recent) sediment based studies. Such studies have the potential to contribute significantly to the effective environmental management of an important and sensitive area.