Geochemical and Sr-Nd-Hf isotopic variations in Tajikistan loess: In search of source and climatic proxies

SYLVAIN GALLET[1] AND BOR-MING JAHN[2]

[1]Department of Geosciences, National Taiwan University, 10617 Taipei, Taiwan (sylvain.gallet@gmail.com)
[2]Institute of Earth Sciences, Academia Sinica, Taipei 115, Taiwan (jahn@earth.sinica.edu.tw)

Late Tertiary to Quaternary loess-paleosol sequences provide invaluable record of the changing environment in continental areas during that time interval. Climatic proxies in loess-paleosol sequences have been retrieved by a number of ways, including pollens, grain-size analysis, clay minerals, carbonate or organic matter contents or magnetic susceptibility. Loess source proxies include quartz morphology, heavy minerals assemblages, major and trace elements and Sr-Nd isotopic compositions. Some proxies are useful both as dust source proxy and as climatic proxy. We have been studying various loess-paleosol sequences in the Chinese Loess Plateau (Gallet *et al*. 1996, Jahn *et al*. 2001). On these sections we tested and proved the usefulness of geochemical and isotopic tools in loess research. Recently we extended our area of investigation to Central Asia, and the Chashmanigar (Tajikistan) loess section was chosen because some detailed stratigraphic and magnetic susceptibility data have been published by Ding *et al.* (2002). This section is about 200 m thick and consists of an alternation of loess and paleosol layers. A combination of geochemical and isotopic data is used to trace back the source(s) of these eolian deposits and their weathering history. Isotopic data (Sr-Nd-Hf) for whole-rock samples and for chemically separated fractions allow to document the change in protolith composition in response to climatic and tectonic events in the area. Major-elements, organic matter and carbonate content were measured on whole-rocks samples. Preliminary results show that our previous understanding of loess-paleosol geochemistry, first established on the Loess Plateau of China, is still valid here. Pedogenesis is clearly distinguished by the depletion or relative enrichment of a number of chemically mobile elements. There is a direct relationship between magnetic susceptibility increase in paleosol and depletion/enrichment of some chemical elements. We are currently working to translate this relationship into more quantitative laws.

References

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The effect of variable source of terrestrial organic carbon on geochemical records of atmospheric level of CO_2

ALBERT GALY AND ROBERT G. HILTON

Department of Earth Sciences, Cambridge University, UK (albert00@esc.cam.ac.uk; rgh31@esc.cam.ac.uk)

Carbon isotope analyses of fossil plants ($\delta^{13}C_{plant}$) have been widely used as chemostratigraphic and palaeoenvironmental tools. It has even been suggested that $\delta^{13}C_{plant}$ can be used as a proxy of $\delta^{13}C$ of palaeo-atmospheric CO_2 [1-2]. This parameter is an important variable for calculating p_{CO2} from the $\delta^{13}C$ of soil carbonate [3], the current largest database on records of atmospheric level of CO_2. However, the $\delta^{13}C$ of modern plants varies between species and palaeo-studies have attempted to go around this issue by focussing on monospecific dataset through time [4].

Here, we present evidences that in addition to species, the provenance of the woody debris will also introduce a significant variability in $\delta^{13}C_{plant}$. The transfer of particulate organic carbon (POC) has been studied in suspended material carried by small rivers draining active mountain belts (Southern Alps, New Zealand and Taiwan). In this active mountain belt, sediment discharge is dominated by landslide-derived material. The altitudinal spread of these landslides means that the POC samples vegetation dominated by C3-type plants and therefore having a variable $\delta^{13}C_{plant}$ [5]. Our sampling of pine trees along and altitudinal transect in Taiwan shows a range of in $\delta^{13}C_{plant}$ of 2‰, in line with previous findings [5]. The $\delta^{13}C$ of the POC in a single river sampled throughout the rainy season in Taiwan ranges from -21.5 to -25‰, while the range is >5‰ in Western Southern Alps. Of course not all of these variations can be attributed to a variable isotopic composition of the vegetation and the fossil component can be as large as 90%. But in some Taiwanese rivers this fossil component corresponds to the recycling of Miocene woody debris. Based on these observations, we would argue that the use of $\delta^{13}C_{plant}$ for calculating p_{CO2} is of very little help and also that it can be misleading in chemostratigraphy.

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