Aeolian dust palaeo-climate records in a Holocene loess

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A loess profile without human interference was found to accumulate only during the Holocene at an altitude of 1668 m in Donglingshan (42°02′ N, 115°27′ E), Beijing. The site is covered by *sub-alpine type meadow* and can be divided into two layers including a soil layer (0-40 cm) and a loess layer (40-104 cm). The ^{14}C ages of organic carbon (OC) and charcoals were determined using the AMS methods. The OC contents, OC $\delta^{13}C$ values and magnetic susceptibility (MS) were also analyzed within the same sample. Results showed that the ^{14}C ages of OC in the soil layer range between 0-3.0 ka BP and exhibit a linear correlation with depth. While in the loess layer, the ^{14}C ages of OC range from 3.0 ka BP to 10.0 ka BP and were generally older than that of charcoals within the same layer.

A model age based on the ^{14}C ages of OC in the soil and charcoals in loess was established for the loess profile. Compared with the model age, the ^{14}C ages of OC in the loess that accumulated since 8.0 ka BP were generally deviated. Three significant deviations were observed at 3.3 ka BP, 5.6 ka BP and 7.8 ka BP, respectively in the loess profile, with a deviation of ^{14}C age about 1.7 ka to 2.5 ka. Consistent with the three significant deviations, the pedogenesis was very weak as indicated by the particularly low MS values. These deviations probably reflect the increased contribution of aeolian dusts containing OC with older ^{14}C ages, either from the source regions of the loess or from surrounding regions that undergone serious erosion during these periods, similar to those observed in modern loess. No such deviation was showed in the soil layer, indicating less contribution of the aeolian dust to the soil accumulation since 3.0 ka BP. The site likely experienced a cold and dry climate around 3.8 ka BP as indicated by large amount of charcoal from *arbor* at 54 cm to 59 cm in the profile, which implies increased fire intensity [1]. As evidenced from the OC $\delta^{13}C$ values, which vary from -22.8‰ to -26.5‰, the proportion of C_4 plant was likely to decline since the end of the Holocene Optimum in the northern China.

[1] Zhou B. *et al*. (2007) *Palaeogeography Palaeoclimatology Palaeoecology* **252**, 617–625.

Insights for CO_2 sequestration from mineral-fluid-gas interactions in mine waste

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Carbon cycling in mine waste operates on a scale and rate that can rival the generation of greenhouse gases in large industrial operations. Carbon exchange occurs via kinetically controlled mineral-microbe-fluid-gas reactions in an environment that is readily accessible for isotopic, mineralogical and geochemical characterization. At four mine sites in northern Canada and western Australia, these data suggest carbon cycling between geologic, industrial, and atmospheric reservoirs at rates that vary by several orders of magnitude as influenced by local climate and tailings handling practices.

Carbon reservoirs are distinguished by their stable (O, C) and radiogenic (C) isotope composition which is sometimes reflected in the composition of minerals that fix carbon. In systems with the most vigorous carbon exchange, however, kinetic fractionation of ^{13}C between gas and water complicates the interpretation of stable isotope data. Radiocarbon isotope data have consistently proven the most reliable in distinguishing between carbon reservoirs.

Rates of carbon fixation are reconcilable with predictions from geochemical models that employ laboratory mineral dissolution rates. Geochemical modelling also identifies optimal scenarios for accelerating carbon fixation that have been demonstrated in bench-top experiments. Further calibration and verification of geochemical models with observations from mine wastes and field experiments will enhance our ability to engineer mine waste handling practices that maximize carbon uptake. Preliminary application of these geochemical models for geosequestration in ultramafic-hosted aquifers provides significant but untested estimates of the rates of carbon mineralization in the subsurface.