Structurally bonded water in sediment soil samples from the Atacama Desert, Chile

C. VOIGT[1]*, D. HERWARTZ[1] AND M. STAUBWASSER[1]

[1]Institute of Geology and Mineralogy, University of Cologne, Zülpicher Str. 49b, 50674 Cologne (*correspondence: c.voigt@uni-koeln.de)

In the hyperarid core of the Atacama Desert soil waters consist mainly of structurally bonded water of hydrated minerals such as gypsum ($CaSO_4 \cdot 2H_2O$). Their oxygen and hydrogen isotopic composition may yield information about hydrological processes, water sources and possibly (paleo-)humidity.

We have investigated sediment samples from two depth profiles (Yungay: 24°6'6.1"S 70°1'5.8"W; Pisagua: 19°36'27.4"S 70°6'9.9"W) and an altitudinal transect along an alluvial fan (Quebrada Aroma). The samples were characterized in terms of their mineral composition by XRD. Water extracted from those samples was analyzed by dual-inlet IRMS ($\delta^{18}O$, $\delta^{17}O$) and continuous flow ($\delta^{18}O$, δD).

Studied samples represent mixtures of two different mineral suites. The silicate suite (quartz, feldspars, muscovite) is probably derived from local weathering of Andean bedrock, while the salt suite (mainly gypsum, anhydrite, halite and nitratite) originates from aeolian redeposition of material from salars and local soil evaporation as well as – when preserved – atmospheric deposition. Samples from the alluvial fan surface are dominated by minerals from the silicate suite, while samples from the soil profiles contain various proportions from both suites.

The isotopic signatures of the extracted waters seem to represent mixtures of adsorbed water and structurally bonded water in gypsum with a possible contribution from water adsorbed onto clays. $\delta^{18}O$ and δD mostly represent heavy evaporitic waters. Back extrapolation to the MWL gives $\delta^{18}O$ between -15 and -30‰ and δD between -100 and -200‰, which indicate light atmospheric water sources rather than local meteoric waters.

Several water samples especially from the deeper parts of the soil profiles comprise strongly elevated ^{17}O-excess values. These represent most likely mass-independent signatures. Pending further tests, these could indicate either an atmospheric origin of the extracted water – and thus the gypsum – or derive from interaction between soil moisture and present nitrates known to carry a mass-independent signature.