Evolution of late Paloeozoic terrestrial environments: the early Permian lake systems in the Saar-Nahe Basin, western Germany

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Lake sediments offer a great potential for reconstructing ancient biogeochemical processes that reflect the chemical budget of the lake system, biologically driven processes within the water column and the sediment as well as the pertinent climatic conditions during deposition (Lerman et al., 1995).
In order to reconstruct paleoenvironmental conditions during the late Paleozoic, we focus our study on the early Permian lake sediments of the Saar-Nahe Basin (western Germany). These are particulaly suitable for studying the stable isotopic composition (C, O, S, N), biogeochemistry and palynofacies due to of the relatively low degree of thermal maturation (vitrinite reflectance between 0.77 and 1.27%)
The first object of interest was the Odernheim lake system (Meisenheim Formation, Odernheim-Schichten) from the Lower Rotliegend (295 Ma). This paleolake had a surface area of roughly 720 km^2 (for comparison, Lake Constance has a surface area of 571 km^2). It was one of the smaller lake systems in the Rotliegend of the Saar-Nahe Basin and shows a good lithological and paleontological variety. Throughout large parts of the stratigraphy, sediments display (sometimes extremely) fine lamination (<1 mm), which probably represent varves.
Abundance data for total carbon, total organic carbon and total sulphur are quite variable. Organic carbon and sulfide sulfur display a positive correlation. $\delta^{13}C$-values for total organic carbon vary between -27‰ and -21‰. A variation in $\delta^{13}C$ from –24 to –21 ‰ upwards in stratigraphy reflects the temporal evolution of the lake system, punctuated by finely laminated intervals with higher TOC and more negative $\delta^{13}C$-values.

References

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Chemical diversity among comets: Implications for delivery of water and prebiotic organics to early Earth

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The organic volatile compositions of Oort cloud comets reveal the existence of chemical diversity in the 5-40 au region of the proto-planetary disk. When coupled with dynamical models, this diversity suggests that comets from the Jovian-Saturnian region (5 - 10 au) delivered oceans and prebiotic organics to Earth. Recently, the first example of this once-dominant population may have been identified.

We investigate organic volatiles and water in Oort-cloud comets at infrared wavelengths. The most powerful application is achieved using NIRSPEC, a cross-dispersed echelle grating spectrometer at the W. M. Keck Observatory. For reasonably bright comets, we measure the production rates of seven parent volatile species in a space of two hours, including H_2O, CO, CH_3OH, CH_4, C_2H_2, C_2H_6, and HCN. Other parent species (e.g. NH_3, OCS, H_2CO) are sometimes measured too, along with several daughter fragments (CN, OH, NH_2, etc.).

Long-slit spectra are taken at high spectral dispersion and high spatial resolution, eliminating several sources of systematic error. The resulting parent volatile production rates are highly robust, and this permits a sensitive search for compositional diversity among comets. Eight Oort cloud comets have now been investigated in this way.

Of six OC comets, four have compositions similar to that of comet Halley (excepting CO). Several of them reveal low formation temperatures (~30 K), so this group (called Neptune-class) probably formed beyond 30 au from the young sun.

A fifth comet (C/1999 S4 LINEAR) is depleted in hypervolatiles and also in methanol, and it likely formed near 5 – 10 au (called Jupiter-class). A sixth (C/2001 A2) is enriched in ethane – its formation zone will be discussed. Preliminary reductions for two other comets (C/2000 WM1 LINEAR) and (C/2002 C1 Ikeya-Zhang) suggest that WM1 is similar to the Neptune-class comets while I-Z may be intermediate.

An emerging hypothesis is that about 2/3 of comets now in the Oort cloud were formed beyond 30 au of the young sun. The remaining 1/3 formed between 5 and 30 au. Although under-represented in today's Oort cloud for dynamical reasons, the Jovian-class group dominated the population of icy planetesimals in the protoplanetary disk (5-40 au) and thus they likely delivered water and pre-biotic organics to early Earth. Measurements of HDO/H_2O in future comets are planned, to test this hypothesis.

References

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