Genesis of low-mineralised groundwater in a fissured sandstone aquifer, Odenwald, Germany – Where has all the sulfate gone?

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Extensive hydrogeochemical data sampling has been carried out on groundwater in a fissured sandstone aquifer in the Buntsandstein formation of the Odenwald, Germany. The sediment rock sequence comprises quartz arenite and quartzitic sandstone with various content of biotite, K-feldspar, and clay minerals. The poorly-mineralised groundwater show conspicuous variation in ion concentrations and in groundwater composition in a range from Ca-HCO_3 to Ca-Mg-SO_4-HCO_3-type.

Groundwater pumped from wells in the sandstone aquifer shows a significant and marked decrease in sulfate concentration in comparison with spring water from the same area. A significant variation in Ca-Mg-ratio between spring- and well-groundwater samples is also indicated. Springs show low ratios of about 2, whereas wells are distinguished by higher ratios due to progressive calcite solution. The individual groundwater composition appears to be related to distinct mineral (rock) alteration mechanisms. It can be shown that alteration of silicate minerals in the aquifer is tied to the HCO_3-buffer system. Significant differences in water composition result from the presence of detrital feldspars in some sandstone units compared to strata that lack feldspar. Leaching experiments on representative sandstone samples produced leachates that were potassium dominated due to K-feldspar alteration. These findings are in sharp contrast to the very low potassium concentrations in the sampled waters. Fluid inclusions in the original detrital quartz grains contribute to the amount of dissolved chloride and sodium. Measured Cl/Br ratios of the leachates are low (50-100) and are diagnostic for saline fluid in basement complexes. Thus, chloride/bromide ratios reflect fluids from the crystalline basement that formed the pre-deposition source of the sandstone.

Ivory Coast tektites, microtektites, and glassy fallback particles of the Lake Bosumtwi impact crater, Ghana: Geochemical differences

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Lake Bosumtwi, a unique young impact structure

The ~ 10 km-sized 1.07 Ma old Lake Bosumtwi structure, Ghana, is the source crater of tektites (Ivory Coast [IVC] strewn field), microtektites (off-shore drill cores), and fallback particles (ICDP drill core LB-05B). These various glass types may have formed during different stages of cratering by different processes, whose mechanics are not known in detail.

Major element composition

Here we present electron microprobe data for the named glassy materials. Two IVC tektites show low SiO_2 (65.5 and 66.1 wt%) and medium to high CaO contents (4.2 and 3.3 wt%). Ten microtektites (drill hole K9-56) have SiO_2 contents between 63.3 and 67.3 wt%, the other major elements also compare well with published data (Glass, 1969, 2004; Koeberl, 1997), and the microtektites are homogenous in general. One, however, displays irregularly shaped domains of different chemical composition in which Mg, Al, K, and Fe contents increase with decreasing Si and Na contents. This microtektite shows low average concentrations of SiO_2 and Al_2O_3 (63.3 and 14.9 wt%, repectively), and high average FeO and MgO contents (7.6 and 6.7 wt%, respectively). Another microtektite (ODP hole 664) is characterized by remarkable low SiO_2 (55.8 wt%), Na_2O (0.7 wt%), and K_2O (0.5 wt%) and high FeO (8.5 wt%), MgO (13.6 wt%), and CaO (2.1 wt%) concentrations. Results of thirteen fallback particles are concordant to data of Luetke *et al*. (2007). In general, IVC tektites, microtektites and fallback particles are quite similar in composition, yet significant differences in Ca, and slight differences in Mg and Fe concentrations exist, probably caused by the particular mixture of precursor materials. Current LA-ICP-MS studies may help to understand the formation processes of the various glasses by detection of different trace element characteristics.

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