Transformation of nitrogen during sediment burial history

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Many gas reservoirs contain appreciable percentages of gaseous dinitrogen besides the commercial valuable hydrocarbon gases. The source of this nitrogen and its transformation path to gaseous dinitrogen is still a matter of ongoing research (cf. [1], [2]).

To follow the transformation of nitrogen in organic rich sediments and sedimentary rocks during burial history with increasing pressure and temperature different approaches have been followed in this study: (1) Two sets of natural maturity series of type II or type III kerogen containing sediments and sedimentary rocks have been analysed with respect to several forms of nitrogen: exchangeable NH_4^+, N in the bitumen, HCl-hydrolysable N (amino-N in kerogen and N in clay minerals), kerogen bound N and N fixed in feldspars and other acid-stable minerals. In addition to the concentrations of the different nitrogen forms the nitrogen isotopic composition was investigated. (2) For the low maturity sediment and sedimentary rock samples artificial heating experiments in closed gold capsules as well as in flexible gold-titanium cells at high pressures and temperatures have been conducted to simulate the natural maturation process.

The results clearly document the release of organically bound nitrogen during early maturation – and a concomittant increase in dissolved inorganic nitrogen concentrations. With elevated ammonium concentrations in the pore water the incorporation of ammonium into authigenic minerals increases. This mineral-bound nitrogen is fixed until the mineral phase is destabilised by higher p-T-conditions or changing aqueous fluid compositions. The final transformation of ammonium released from minerals to gaseous dinitrogen might be a consequence of redox reactions involving mineral surfaces. At very high temperatures dinitrogen might be formed from organically bound nitrogen in type III kerogen.

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U-Pb and Pb-Pb dating of phosphates in Martian meteorites

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There are many studies that measured U-Pb and Pb-Pb ages in phosphates of Martian meteorites. The ages of Shergottites are controversial, ranging from 4 billion years [1] to 200 million years [2] and are not well constrained. The ages are very important for understanding Martian evolution.

Here we show the U-Pb and Pb-Pb ages in several Martian meteorites. ALH84001, Zagami, DaG476 and some other Martian meteorites were investigated. For U-Pb and Pb-Pb dating by NanoSIMS, primary O- ions with a beam intensity of 10nA were used in a spot diameter of about 10-20 micrometer. An apatite from Prairie Lake called PRAP with a known age [3] was used as a standard for $Pb/UO\text{-}UO/UO_2$ calibration. The age of ALH84001 is about 4 billion years and it is consistent with those of the previous studies [4] within the experimental error. Our U-Pb age of phosphate minerals in Zagami are very young, suggesting that it was reset by some recent metamorphism. However the Pb-Pb isochron age at the same spots of U-Pb dating is about 4 billion years. This age is derived from two grains. Our data suggest that Zagami crystallized at 4 billion years ago, and it experienced some recent metamorphism to reset the U-Pb age. At the poster session I will discuss the implication of the U-Pb and Pb-Pb ages of ALH84001, Zagami and other Martian meteorites.

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