

## **$^{40}\text{Ar}$ - $^{39}\text{Ar}$ dating of a melt inclusion from Dhofar 323 (H5): An early impact event**

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Certain unshocked H-chondrites record chronological information of the period shortly after parent body formation [1], e.g. Dhofar 323 [2]. In this weakly shocked (S1) H5 chondrite [3], we found an achondritic inclusion: medium-grained (40-100  $\mu\text{m}$ ) crystalline rock composed of equilibrated olivine, pyroxene, and feldspathic glass, with silicate chemistry similar to that of the host chondrite but strongly depleted in metal and troilite. Hence, this inclusion most probably represents recrystallized impact melt produced on the H-chondrite parent body. Within an ongoing initiative to elucidate chondrite thermal histories [1,2,4,5], we performed high resolution  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  dating. The inclusion age is  $4508 \pm 9$  Ma. It is indistinguishable from the host material [2] and the age of unshocked H5 chondrites reset by thermal metamorphism [e.g. 1,6], and corresponds to about 20-30 Ma after CAIs if corrected for K decay constant bias [7-10]. The presence of this melt inclusion in unshocked chondritic material suggests an early impact event, accompanied by melt penetration into the H5 layer of an onion-shell structured parent body that was slowly cooling after metamorphism. In most cases the impact ages of H-chondrites are  $< 1.3$  Ga [e.g. 6]. The oldest impact-induced H chondrite silicate melt was found in Ourique with an  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  age of  $4.45 \pm 0.02$  Ga [11]. The Dhofar 323 inclusion appears the most ancient achondritic material currently found in H-chondrites.

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## **Chemical and isotopic characterisation of highly saline sedimentary pore water**

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Pore water chemistry and isotopic composition were investigated using common indirect methods (leaching and isotope diffusive-exchange technique) on drillcore samples from the DGR boreholes drilled by Ontario Power Generation (OPG) at Bruce, southern Ontario, into Palaeozoic rock of the Michigan Basin. Previously, these methods were successfully applied to characterise pore waters of the Opalinus Clay drillcore samples from Mont Terri, Switzerland, which showed a maximum Cl<sup>-</sup> content of approx. 14 g/kgH<sub>2</sub>O. In contrast to the Opalinus Clay, however, the Michigan Basin samples are characterised by highly saline pore water, which induces several methodological difficulties.

The conversion of aqueous leaching data to mass of pore water requires the knowledge of rock's porosity and thus its water content, grain and bulk densities. The measurements of densities and water content are, however, affected by the mass and volume of evaporated pore-water salts and the dry weight of the rock sample requires a correction related to the pore water salinity. Applying the common salinity-correction method in combination with the general trend in the depth profile given by the water activity data of the rock samples allows an evaluation of the chloride content and main salt components (NaCl vs. CaCl<sub>2</sub>) of the pore water over a range of salinities from seawater to halite saturation.

The high salinity also affects the indirect methods for the pore-water stable isotope determination. In the isotope diffusive-exchange technique, where the isotope exchange between a test water and pore water of rock samples occurs via the vapour phase, there exists a risk of liquid-vapour isotope fractionation of oxygen and hydrogen between the test water and the highly saline pore water. Differences in the water activity will result in saturation/desaturation processes and possible precipitation of (hygroscopic) salts in the rock sample over the course of the experiment. We propose to minimise this fractionation by fitting the water activities of the test-water solution to that in the investigated rock sample by adding NaCl or CaCl<sub>2</sub> to the test water. Similar perturbations of the *in situ* isotope signature during the experiment and measurements will also have to be expected for other pore-water stable isotope techniques.