ALTERATION OF METAL IN CR2 CHONDRITES: AN ANALOGUE FOR LONG TERM CORROSION PROCESSES

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Introduction: The long term storage of nuclear waste provides a big challenge for material science. The material has to be stored safely for a time frame of at least 10^4-10^5 years – something difficult to simulate in a laboratory environment. In France, the nuclides are stored in a boro-silica glass, which is contained in steel containers, which are stored in a clay-rich geological repository. To gain insight in the long term behaviour of this materials at the metal-glass-clay interface, CR chondrites provide a good analogue. Glassy chondrule mesostasis are similar to the nuclear waste glasses. Abundant larger metal grains help to estimate corrosion processes of the steel container. These components are embedded in a phyllosilicate-rich matrix [1]. CR chondrites also show alteration over the whole range from type 3 to 1, thus allowing the investigation of all steps in alteration of the materials [2, 3]. The physico-chemical environment of the parent body during the alteration (Table 1) is sufficiently similar to that expected in the storage facility [4].

	CR Chondrites	**Storage Facility**
T°C	50-150	40-90
fO_2	$>10^{-55}$–10^{-70}	$>10^{-55}$–10^{-70}
W/R	0.4-1.1	0.1-0.6
Mineralogy	Serpentine, Saponite Calcite, Magnetite, Maghemite, Pyrrhotite, Pentlandite	Serpentine, Smectite, Siderite, Magnetite

Table 1: Comparison environments. Sources: [1-4].

Samples and Techniques: Samples of Renazzo and Al Rais CR2 were selected for their advanced degree of alteration. In a first step, we obtained BSE maps of important areas of the samples, followed by quantitative elemental mapping using an EMPA at Nancy University.

Discussion: In one part of this project, alteration of metal grains inside the matrix of CR2 chondrites is used to investigate the corrosion of the steel container. Preliminary results from big metal grains (>400μm) in Renazzo and Al Rais show multi-layered reaction rims. These rims are fine grained mixtures, probable dominating phases were identified based on element ratios. The grain in Renazzo, which is altered to a lower degree than Al Rais, has a sequence of layers dominated by

FeNi metal/sulfide/iron oxide/carbonate/sulfide/matrix or *FeNi/sulfide/carbonate/matrix*.

The grain in Al Rais has a differerent sequence: layers on one side are dominated by

FeNi/iron oxide/ sulfide /phosphate ± carbonate/sulfide/matrix.

The rim on the other half is mainly sulfide.

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References: [1] Weisberg et al. 1993 *Geochimica et Cosmochimica Acta* 57 1567-1586 [2] Abreu 2007, PhD thesis [3] Weisberg M.K. and Huber H. 2007 *Meteoritics & Planetary Science* 42:9 [4] Zolensky, M. et al. 1993 *Geochimica et Cosmochimica Acta* 57, 3123-3148