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TRANSFORMATION OF SI-MG(-AL) GELS INTO MAGNESIAN CLAYS BY HYDROTHERMAL REACTION IN SEAWATER. THE CASE OF STRýTAN ALKALINE VENT (ISLAND)

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Hydrothermal circulation of seawater through the oceanic lithosphere has played a major role in the prebiotic chemistry and habitability of the oceans. This is due to the permanent chemical disequilibrium conditions that exist between the silica-rich alkaline hydrothermal fluids and the acidic primitive ocean. Submarine hydrothermal fields located near Iceland (Strýtan) are considered as possible analogues of places on the early Earth that could have hosted the emergence of life due to the existence of significant ionic gradients capable of sustaining life in inorganic membranes.

Strýtan is a shallow hydrothermal system consisting of three columnar structures 25-55 m high located 65 m deep on the eastern slope of Eyjafiord in North Iceland [2]. Hydrothermal activity occurs primarily in the largest structure, with a flow of about 50 L/s of a fluid at a temperature of 60-72 °C. It is a low-salinity, silica-enriched, alkaline fluid with a non-significant H_2S and metal content. The chimneys in Strýtan are composed mainly of amorphous silicates, magnesian clay minerals, and occasionally carbonates.

This project aims to elucidate the processes of chimney formation by precipitation of the constituent minerals. Synthesis experiments were conducted to simulate underwater hydrothermal conditions at low temperatures and pressures (50, 80, 110°C). The starting material was magnesium (aluminum) silicate gels obtained by coprecipitation from the mixture of Na2SiO3 and MgCl2 (AlCl3) solutions, to obtain a Si:Mg ratio close to saponite [3]. Two types of gels were prepared, a SiMg (4:2.3) gel and a SiMgAl (4:1.7:0.4) gel. The hydrothermal treatment was carried out with synthetic seawater for 1 to 6 months, and the solid products were characterized by XRD, SEM-EDS, TEM-AEM.

After aging for 1 to 6 months, the starting gels show partial transformation into a low crystallinity phyllosilicate, characterized by diffraction bands at 1.54-1.53 Å. The gel grains were formed by rounded nanometric particles, being more compact in SiMg gel. Small flakes and honeycomb structures developed on the surface, which are characteristic of smectites. No difference in composition was observed from particle to particle. Nanodomains with 2-4 layers of 7 Å periodicity were identified by TEM. Temperature apparently favored the gels transformation, but no relevant differences were observed with time. Compared with natural samples, gels seemed to mimic the first stage of crystallization of Mg-silicates in Strytan, although further evolution was not observed under our experimental conditions (temperature, time, absence of flow). The absence of flow in the experiments prevented the development of characteristic structures associated with flow conditions. Currently, experiments are being conducted in conditions closer to those observed in the submarine vent.

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