ALTERATION OF IMPACT MELTS. H. Dypvik[1], H. Hellevang[1] and E. Kalleson[1], [1]Department of Geosciences, University of Oslo, P.O. Box 1047 Blindern, NO-0316 Oslo, Norway (henning.dypvik@geo.uio.no, helge.hellevang@geo.uio.no, elinkal@geo.uio.no,).

Introduction: The formation and deposition of melt/glass and melt/glass-carrying sediments is common during impact cratering, [1], [2]. In this process some of the target rocks are melted, mixed with impactor remnants and possibly ejected; about half of the melt remains within the crater. These amorphous (+ fine crystalline) phases are later frequently altered, often to phyllosilicates/clay minerals, [3].

In this project we aim at better understanding of the alteration processes of melt rocks and impact melt in particular. By experimental analyses and modeling of both volcanic (basaltic and rhyolitic) and impact glass we study melt alteration. Most of the impact related samples are glass- or melt-rich rocks from several different impact structures of various ages and in different target lithologies (Chesapeake Bay, Chicxulub, El'gygytgyn, Gardnos, Kärdla, Lappajärvi, Ries, Ritland) (Fig. 1).

Fig. 1. Almost clast free melt rock from Lappajaärvi, Finland. The rock piece is 4 cm across.

Experimental setup: The experiments are conducted at hydrothermal temperatures (between 200 and 230°C) and 15 bar pressure, by 3 weeks percolation in Parr© stirred titanium batch reactors (Fig.2). We are using saline solutions containing 30 mg/l NaCl, close to the composition of normal, marine water. The experiments are aiming at representing the conditions found in the melt bearing rocks the first few thousand years after deposition. The geochemistry/mineralogy of samples and reaction products are studied before and after the alteration experiments (dissolution and precipitation). Finally the results are compared to outcome of geochemical modeling (PHREEQC) in order to increase our understanding of the chemical reactions during alteration.

Fig. 2. The experimental setup with Parr © titanium reactor.

Results: The alteration products reflect the composition of both the source materials and the percolating water. The first results (artificial melts and Chesapeake Bay impact melt) show the formation of smectite, chlinochlore, Fe-pyrophyllite, saponite, analcime, talc and philippsite, [4], [5].

Recent experiments on basaltic glass (volcanic) shows the formation of talc, analcime and smectite (Figs. 3, 4).

During the studies we aim at explaining and demonstrating the formation of phyllosilicates / clay minerals (e.g. smectite, saponite), zeolites (e.g. analcime, heulandite, philippsite, harmotom) and other minerals related to impact melt/glass alteration. These minerals are found as natural alteration products of impact melts on the Earth [3], but similar minerals have been suggested to appear on the surface of Mars e.g., [6], [7]. On the Earth, as well as on Mars, additional processes such as surface weathering and post depositional diagenesis may affect the mineralogical transformations, [8]. In this project we study the alteration processes and see how it reflects both the composition of source melt/glass and percolation water.

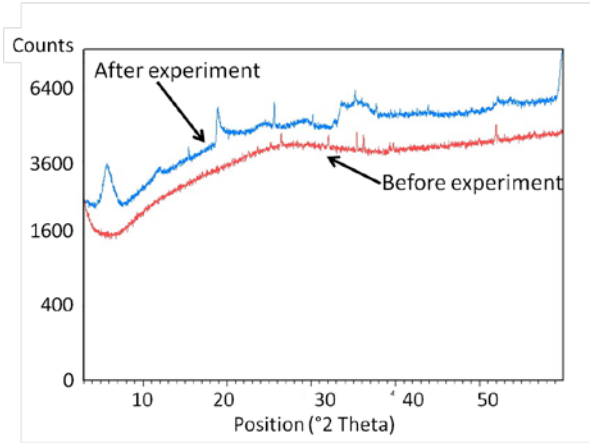

Fig. 3. XRD diagrams showing the alteration of basaltic glass at 230°C over 3 weeks; smectite, talc and zeolites formed.

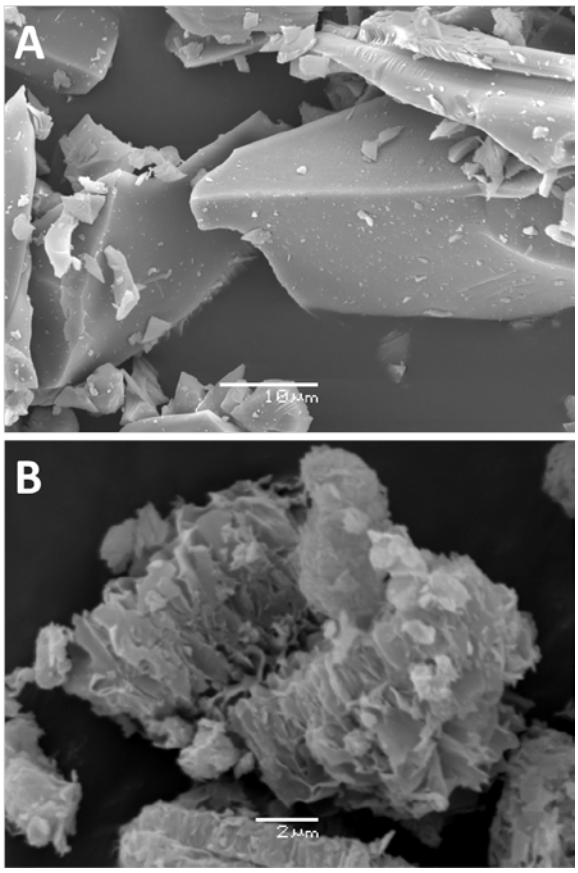

Fig. 4. Alteration of basaltic glass to smectite. A. SEM micrograph of basaltic glass used for alteration experiments. B. SEM micrographs showing crenulated to flaky smectite from basaltic glass altered at 230 °C for three weeks.

References:

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