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Suspended matter/seawater interaction following the 1996 outburst flood from the Vatnajökull Glacier, Iceland

M. B. Stefansdottir (1) and **S. R. Gislason** (2)

(1) Public Roads Administration, Reykjavik, Iceland (2) Institute of Earth Sciences, University of Iceland, Reykjavik, Iceland, (sigrg@raunvis.hi.is /Fax: 354-525-4499)

The 1996 Gjálp subglacial eruption within the Vatnajökull Glacier, Iceland triggered a catastrophic outburst flood, bringing at least 180 million tonnes of suspended solids to the sea in only 42 hours. This amounts to 1% of the total annual global river suspended flux to the oceans. The specific BET-surface area of the suspended solids was measured to be 11.8 - 18.9 m2/g, translating to the average total BET-surface area of $2.8x10^9$ km^2, providing enormous potential for adsorption/desorption and precipitation/dissolution fluxes at the suspended solids - ocean water interface. Altered basalt glass was the major constituent of the suspended matter (80%), secondary minerals such as zeolites and calcite amounted to 11%, but only 5% was fresh volcanic glass. The behaviour of 28 elements on the surface of the suspended solids exposed to seawater was quantified by experiments in the laboratory. The elements generally showed a distinctive pattern during the experiments, which may be explained by adsorption/desorption and non-steady state precipitation/dissolution. The altered basaltic glass dissolved in seawater, as recorded by the Si release from the glass. The dissolved concentrations of Na, Ca, Si, Ba, Cd, Co, Cu, Hg, Mn, Ni, and total dissolved inorganic N increased considerably when the suspended solids come into contact with the seawater, but the concentrations of Mg, K, S, Sr, Fe, Pb and Zn decreased. The rate of release (mol/m^2/s) of Si, Mn, Ba, Co, Ni and Cd decreased continuously during the one week exposure to seawater. After one week, the logarithm of the dissolution rate of the altered basaltic glass was –11.9 to –11.6 (Si mole/m^2/sec). Significantly lower than the steady-state rates for fresh basaltic glass at similar conditions (Gislason and Oelkers 2003). Calculated one day desorbed/dissolution suspended material fluxes are greater than the integrated dissolved flood fluxes for Mn, Ba, Ni, Co and Cd, but the

Si dissolved flood flux was greater than the one day desorbed/dissolved suspended material flux.

Gislason, S. R. and Oelkers, H. E. (2003). The mechanism, rates and consequences of basaltic glass dissolution: II. An experimental study of the dissolution rates of basaltic glass as a function of pH and temperature. Geochim. Cosmochim. Acta, 67, 3817-3832.