

## Denudation rates in NE-Iceland. Evolution of a steady state model of erosion

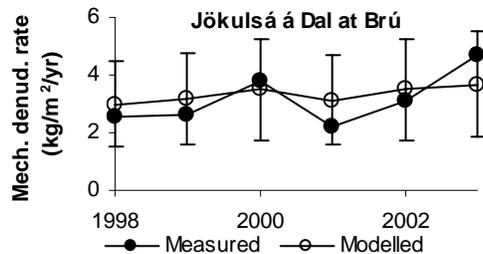
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This study critically assesses the temporal sensitivity of a steady state model of erosion that has been applied to various chemical and mechanical weathering studies worldwide. The model assumes a geochemical mass balance between the initially unweathered rock of a drainage basin and the weathering products (Gaillardet *et al.*, 1995).

The model was applied on 89 samples of river dissolved and suspended matter collected during 1998-2002 from five basaltic glacial river catchments in NE-Iceland. The steady state model of erosion was sensitive to the seasonal changes of the dissolved constituents in the rivers. However, the measured and modelled results are within the error of the method. The modelled concentrations of the suspended inorganic matter were most consistent to the measured ones, when the average annual chemical composition of the dissolved- and the suspended matter was used in the modelling (figure 1).



These results validate the use of a steady state model of erosion in estimating the denudation rate at a catchment scale. Best results are gained when samples are collected at close to average dissolved loads of the rivers.

### References

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## Dehydration processes determine fO<sub>2</sub> of arc and intraplate magmas

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Chromite inclusions within early-crystallised olivine phenocrysts (Fo>85 mol%) in most arc lavas have lower Fe<sup>2+</sup>/Fe<sup>3+</sup> ratios than similar inclusions from MORB. This can be calculated to reflect a higher oxygen fugacity ( $\Delta FMQ > +2$ ) in the source region of arc magmas compared to the source of MORB ( $\Delta FMQ < +1$ ). This higher oxygen fugacity in arcs is likely related to the "subduction component" added to the asthenospheric, MOR-like mantle. Aqueous fluid by itself is a very inefficient medium to increase the mantle's oxygen fugacity, so it has been proposed that Fe<sup>3+</sup>-bearing melts are involved (Frost and Ballhaus, 1998). However, not all arcs show influence of a slab-derived melt.

We propose that the observed higher oxygen fugacity in arcs is related to the dehydration of serpentinites, formed in either the downgoing slab or the forearc mantle. Serpentinisation involves the hydration and oxidation of olivine and pyroxene, and generation of serpentine, magnetite,  $\pm$  brucite, H<sub>2</sub>  $\pm$  CH<sub>4</sub> (Frost, 1985). Serpentinites release their water into the sub-arc mantle by formation of olivine and orthopyroxene at  $\sim$ 2-3 GPa and 700-750°C. Olivine is always more iron-rich than its equilibrium serpentine (Evans, 2004) and neither olivine nor orthopyroxene can accommodate Fe<sup>3+</sup>, so ferric iron from magnetite needs to be reduced to be incorporated into these minerals. This reaction will liberate oxygen that is carried into the mantle wedge with the aqueous fluid, explaining the high oxidation state of the sub-arc mantle.

Dehydration of the similarly oxidised metabasaltic portion of the subducted slab leads to the formation of an eclogitic mineral (cpx-gt) assemblage, which does not discriminate against Fe<sup>3+</sup> in the same manner as ol-opx. This material is subducted into the deep mantle, and recycled to form OIBs. This model agrees with the oxygen fugacity of OIBs being intermediate between that of MORBs and arcs.

### References

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