Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20614

# Variable K-uptake into the upper oceanic crust due to strong temperature and dissolved silica control on the formation on secondary K-feldspar

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Potassium is one of the major elements in seawater with a concentration range between 9 and 11 mmol $L^{-1}$. Remarkably, from proxies for paleo-seawater composition such as primary fluid inclusions in halite it seems evident that the concentration of K in seawater remained in this range throughout the Phanerozoic. Hence, this suggests that sources and sinks of K in the ocean are roughly in balance. However, the relative role of the K sinks in the ocean are incompletely understood. Here, I focus on testing off-axis, hydrothermal systems as a variable sink through geological time. Potassium in these systems is mainly taken up by formation of secondary K-rich phyllosilicates (celadonite) and K-feldspar. From these K-feldspar is rarely observed in Cenozoic altered oceanic crust but present in Mesozoic crust. Compiled bulk geochemical data of ocean drill core samples suggests that the K-content in Mesozoic increased compared to Cenozoic crust. Also, radiometric dating studies of celadonite suggest that, with some exceptions, K is taken up into the crust within the first ~20 Myr [1]. From these lines of evidence, it is hypothesized that K-feldspar formation in altered upper oceanic crust and thus the variable K-sink in off-axis systems is controlled by environmental parameters such as seawater pH and temperature [2]. Here, I perform simple geochemical modelling to isolate the impact of these first parameters on the saturation of K-feldspar in equilibrium with primary plagioclase, secondary Na-beidelleite. This modelling showed that changes in temperature in the range of ~10 °C warmer Mesozoic seawater leads to a strong increase in equilibrium K concentration in the off-axis fluid at constant Si content. However, an increase in fluid temperature also increases the dissolution rate of basalt which would lead to increased silica concentrations in off-axis fluids which increases the saturation of K-feldspar. Hence, a coupled model between changing temperature and Si content best explains the observed changes in mineralogy in altered upper oceanic crust through time. References: [1] Laureijs, C. T., Coogan, L. A. & Spence, J. *Chemical Geology* 579, 120339 (2021); [2] Coogan, L. A. & Gillis, K. M. *Geochemistry, Geophysics, Geosystems* 14, 1771–1786 (2013).