On the potential for CO_2 mineral storage in continental flood basalts

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Continental flood basalts (cfb) are considered as potential objectives for CO_2 storage because they contain abundant divalent cations and therefore have a potential for mineral trapping of CO_2 [1]. Lateral extensive cfb are found in many place in the world within distance from major CO_2 point emission sources.

The potential of cfb to store CO_2 in secondary carbonates was evaluated. Based on mineral assemblage, formation water composition of Colombia River Basalt [2], we estimated the reactive surface of the basalt to be approximately 1/1000 of the total pore space surface. Kinetic dissolution of primary basalt-minerals (pyroxene, feldspar and glass) and local equilibrium assumption for secondary phases (weathering products) were applied for the simulations.

According to the simulations result, formation of carbonates in basalt rock at 40 ºC and CO_2 100 bar is limited, and only small amount of siderite and ankerite formed. Calcium was largely consumed by zeolite instead of forming Ca-carbonates (Figure 1). Potential of carbonate formation is sensitive to reservoir temperature and CO_2 pressure, with intermediate pressures giving more secondary carbonates than the highest pressures. The amount of carbon stored in solid phases after 10.000 years is small relative to solution trapping (approximately 0.23 %).

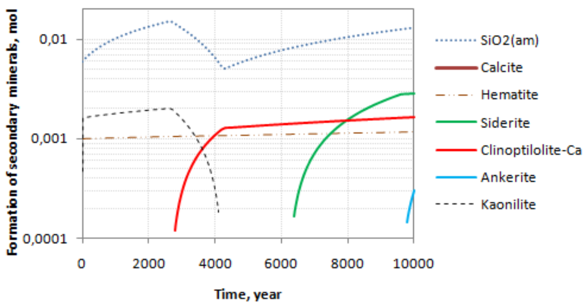

Figure 1: Secondary minerals formed in the batch simulation with the present of injection CO_2 at 40 °C, 100 bar. Only amounts of siderite and ankerite formed in thousand years.

[1] Oelkers *et al*. 2008. *Elements* **4**, 305–310. [2] Reidel *et al*. 2002. *Report Pacific Northwest National Laboratory*, PNNL-13962.

Crustal contribution to the geo-neutrino flux at the Sudbury Neutrino Observatory (SNOLAB)

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Recent improvement in the observation of geo-neutrinos, i.e. low energy anti-neutrinos produced by β decays in the series of radioactive elements U and Th, will permit a direct determination of the abundance of these radio-elements in the mantle and their contribution to the earth's energy budget.

The major fraction, about 80%, of the geo-neutrinos, that will be detected in continental observatories come from the continental crust nearby. In order to estimate the flux from the mantle, we need to precisely account for the crustal contribution.

Crustal radio-activity can be best determined from surface heat flux data which integrate the entire crustal column and are unaffected by small scale heterogeneities.

We analyze heat flux and heat production data to calculate the crustal contribution to the total geo-neutrino flux that will be observed at the Sudbury Neutrino Observatory (SNOLAB).

With all the available data, we show that the heat production is very heterogeneous but that the Sudbury region has significantly higher heat flux than the average Canadian shield (53 mWm^{-2} vs 42 mWm^{-2}). This elevated heat flux is due to the high heat production (>1.5 μWm^{-3}) in the upper part of the crust which is usually enriched in radio-elements.

This high crustal radio-activity leads to as much as 50% increase of the local crustal component of the geo-neutrino flux that will be observed at SNOLAB.