Application of Clumped Isotopes to the Dolomite Problem

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The measurement of clumped isotopes has been applied to Miocene to late Pliocene dolomites from San Salvador, Bahamas. These dolomites formed as recently as 500 ky BP, yet are texturally mature and display near perfect stoichiometry (46-48% $MgCO_3$). They were proposed to have formed at low temperatures (20-28°C) and from normal to slightly evaporated sea water[1]. Given the well constrained environmental conditions, these dolomites offer the opportunity to test the application and accuracy of the various calibrations for relating Δ_{47} and temperature. Accurate temperatures of formation can than be used to determine which of the multitude of formulas for determining the fractionation of $\delta^{18}O$ between the dolomite and the fluid is most accurate.

The dolomites returned Δ_{47} values from 0.64‰ to 0.68‰. Based on the analysis of these samples and the application of the various formulas for relating Δ_{47} to temperature, we propose a modified Dennis *et al*. (2011)[2] method which takes into account the temperature difference between the theoretical calibrations for dolomite and calcite proposed in Guo *et al*. (2009)[3]. This method produced temperatures ranging from 23.3°C to 41.5°C. All other methods proposed in the literature produced temperatures that were considered too high considering the well constrained depositional and diagenetic setting of these samples.

Using the modified Dennis *et al*. (2011)[2] method, it has been concluded that the $\delta^{18}O_{dolomite\text{-}fluid}$ fractionation equation of Sheppard and Schwarcz (1970)[4] produces the most reasonable water $\delta^{18}O_{water}$ values considering our interpretation of the temperatures.

[1]Swart, Ruiz, & Holmes(1987), Geology *5*, 262-265. [2]Dennis, Affek, Passey, Schrag, & Eiler (2011), Geochimica et Cosmochimica Acta *75*, 7117-7131. [3] Guo, Mosenfelder, Goddard III, & Eiler (2009), Geochimica et Cosmochimica Acta *73*, 7203-7225. [4] Sheppard & Schwarcz (1970), Contr. Mineral and Petrol. *26*, 161-198.

Helium isotope compositions of geothermal fluids and alkaline volcanics in Turkey: A comparative assessment for crust-mantle dynamics

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As a part of the Alpine-Himalayan orogenic belt, the Anatolian land has experienced a series of volcanism, plutonism and active tectonism since the Neogene. This unique geologic disposition facilitated occurrence of vast number of fossil and modern geothermal systems which are closely associated with Neogene-Quaternary volcanism in areas of seismic unrest. He-CO_2 systematics of geothermal fluids in Anatolia has been the subject of several studies over the last decade. He-isotope compositions, reported as R/Ra values, vary over a wide range from 0.27 to 7.76 (Nemrut caldera-eastern Anatolia). The mantle-derived helium component, which is likely transferred to the crust beneath Turkey by recent magmatism, constitutes up to 96% of the total He composition in fluids. $CO_2/^3He$ ratios varying from $2.4x10^5$ to $26x10^{13}$ encompass the range of island arcs ($\sim 2.0\times10^{10}$) and continental fluids ($>10^{11}$). Additionally, in this work new helium isotope data are presented for mantle-derived xenolith-bearing basaltic lavas from the Thrace basin in NW Turkey as well as olivine-bearing volcanic rocks from western and southern Anatolian regions. The peridotite xenoliths from the Thrace alkaline volcanic suite are composed of spinel-harzburgites and dunites. Homogenous $^3He/^4He$ ratios (6.7-7.1 Ra) of harzburgites are very close to that of MORB-type mantle. One dunite sample from the same region is represented by a lower helium isotope composition (3.0 Ra). Alkaline basalts from Kula (western Anatolia) and Osmaniye (southern Anatolia) areas have $^3He/^4He$ ratios of 7.9 Ra which is coincident with values typical of upper mantle. Olivine in basalt sample from the Söke area in western Anatolia yielded lower helium composition (1.9 Ra). Our ongoing survey on isotope compositions of noble gases in Turkish volcanics, will lead to a better understanding of these apparent anomalies in regard to temporal changes in crust-mantle dynamics in the eastern Mediterranean.

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