# $^{238}$U- and $^{232}$Th-decay series constraints on the timescales of generation and degassing for phonolite erupted in 2004 near Tristan da Cunha

M.K. REAGAN[1], S. TURNER[2], M. LEGG[1], K.W.W. SIMS,[3] AND V. L. HARDS[4]

[1]U. Iowa, Iowa City, IA, USA, (mark-reagan@uiowa.edu)
[2]GEMOC, Macquarie U., Australia., (sturner@els.mq.edu.au)
[3]WHOI, Woods Hole, MA, USA, (ksims@whoi.edu)
[4]British Geological Survey, UK, (vicky@mvo.ms)

Phonolite pumice found floating offshore of Tristan da Cunha following intense seismic activity 20 to 30 km southeast of the island July 29-30, 2004 was analyzed for $^{238}$U- and $^{232}$Th-series nuclides including $^{230}$Th, $^{226}$Ra, $^{210}$Pb, $^{210}$Po, and $^{228}$Th. The initial ($^{210}$Po/$^{210}$Pb) value of 0.16 for the phonolite shows that, like most subaerial lavas, this subaqueous tephra degassed most of its $^{210}$Po upon eruption. The ($^{230}$Th/$^{232}$Th) and ($^{238}$U/$^{232}$Th) values for the phonolite are similar to those of more mafic magmas from Tristan da Cunha. However, in contrast with trachyandesites erupted in 1961 from Tristan da Cunha (Oversby and Gast, 1968), the activities of $^{210}$Pb and $^{230}$Th are both strongly enriched with respect to $^{226}$Ra in the phonolite, which is likely due to $^{226}$Ra partitioning into feldspars and hornblende in the decades leading to eruption. Moreover, the initial ($^{228}$Th)/($^{232}$Th) value was 0.94±0.03 (1σ), suggesting that Ra was being fractionated from Th until just before eruption. These disequilibria were modeled to have resulted from continuous crystal fractionation for about 2 centuries assuming that the fractionation began with a 1961-like trachyandesite and involved hornblende, anothoclase, apatite, and sphene. The implied fractionation rates are 2-3x10$^{-3}$y$^{-1}$, which are one to several orders of magnitude faster than has been calculated for most other magmas. Nevertheless, these rates are similar to those calculated for the relatively low volume (0.1 km$^3$) trachyte erupted from Fogo in 1563 (Snyder *et al*., 2007). These data imply that the 2004 magma was not the differentiated cap of a much larger magma body that remained at depth. Instead, it was likely the residue of a relatively small magma body that migrated rapidly through the crust southeast of Tristan da Cunha and underwent extensive and rapid crystal fractionation.

## References

Oversby V.M. and Gast P.W. (1968), *Earth Planet. Sci. Lett.* **5** 199-206.

Snyder D.C., Widom E., Pietruszka A.J., Carlson R.W., and Schmincke H-U. (2007), *Chem. Geol.* **239** 138-155.

# Carbon isotopes vs temperature: Contact metamorphism in graphitic metapelites at western Venezuela

K. REATEGUI, M. MARTÍNEZ, W. MELÉNDEZ AND S. MARRERO

Centro de Geoquímica, Instituto de Ciencias de la Tierra, Facultad de Ciencias, Universidad Central deVenezuela. Apartado Postal 3895, Caracas 1010 A (katya_reategui@ciens.ucv.ve)

Isotopic characterization of graphitic materials associated with the metamorphic aureole of the La Soledad Granite and the non-carbonatic phyllites of Cerro Azul Association, at western Venezuela, was used to evaluate the correlation between the variations in $\delta^{13}$C with the progress of the metamorphic process.

Raman spectroscopy was used to evaluate the graphite cristalinity and the maximum metamorphic temperature reached. Aditionally, petrographic determination was also applied in this work. The mineralogical assemblage and the presence of andalusite mineral indicated an intermediate methamorphism.

The intrusion process produced, at the contact zone, an increase of $\delta^{13}$C (from -28.3 to -27.5‰) which could be linked with the temperature gradient and hydrothermal fluid action. Isotopic signals showed greater dispersion in zones closer were higher hydrothermal activity was present. However, isotopic data cannot be employed in the evaluation of the metamorphic grade of the rock, because no correlation was found with the calculated temperature derived from spectroscopic parameters (528 to 510 ± 16 °C ). Just a weak correlation with %C (0.4 – 2 %C) in the bulk rock was observed, demonstrating that other aditional factors than kinetic ones could be involved.

Several parameters are affecting %C and $\delta^{13}$C in the studied zone, these are: a) temperature; b) composition of hydrothermal fluids and c) the reactions between hydrothermal fluid with the mineral assemblege present in the the rock, as well as with graphite. Results allow us to infer that, for this type of geological environment, isotopic signature of graphite must not be employed as geothermometer.