NanoSIMS Pb/Pb dating of tranquillityite in lunar basalts

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Ion microprobe U-Th-Pb geochronology was first carried out three decades ago [1-2] to date phosphates and Zr-rich minerals from lunar samples, but was hampered by the limited mass resolution of the instrument. Subsequent analytical developments improved the accuracy and precision of *in-situ* Pb isotope measurements. In lunar samples, *in-situ* U-Pb dating has mostly been focused on zircon (e.g., [3] and refs therein), which occurs in rock types mainly representing the lunar highlands [3], while it is rare in mare basalts in which U and Th, are mostly hosted by baddeleyite, zirconolite and tranquillityite. This latter group of minerals can also yield precise and accurate Pb/Pb ages [4-9]. However, their small sizes often pose serious challenges to application of *in-situ* dating techniques.

We have used the NanoSIMS 50 at the University of Rennes 1 to carry out high-resolution Pb/Pb dating in tranquillityite in mare basalts. The 120-140 pA primary O^- beam produced ~ 3 μm spots. We obtained average $^{207}Pb^*/^{206}Pb^*$ dates of 3713 ± 8 Ma, 3769 ± 8 Ma and 3736 ± 10 Ma for samples 10044, 75055 and 74255, respectively, which we interpret as the crystallisation ages of these basalts. These ages are consistent with previous but provide tighter constraints on the crystallisation of these basalts. The high-spatial-resolution achieved in our dating protocol using the NanoSIMS 50 and the common occurrence of tranquillityite in lunar basalts have opened up a new avenue for carrying out rapid, accurate and precise age dating of mare basalts.

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Evidences of paleoproterozoic metamorphism in the NW region of the Quadrilatero Ferrifero area, Minas Gerais, Brazil: Implications for gold mineralizations

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It was characterized a paleoproterozoic medium-grade metamorphism related to the gold mineralizations in the NW area of the Iron Quadrangle (Quadrilatero Ferrífero), in Minas Gerais State, Brazil. The gold ores are hosted by sericite-chlorite quartz schist from the upper metasedimentary unit of the Rio das Velhas Supergroup, These rocks are metamorphosed under transitional greenschist-amphibolite facies conditions and comprise garnet + staurolite + cummingtonite, biotite + chlorite + plagioclase + quartz; the metamorphic peak is at ca. 600ºC and 6.6 kb. The ore consist of arsenopyrite, pyrite, pyrrhotite and free gold in a gangue made of quartz, carbonates, graphite and oxides (hematite, magnetite and ilmenite). The age of the metamorphism was characterized by Sm-Nd ages for garnet-whole rock and Rb-Sr whole rock isochron with an ages around 2.2 Ga. The 1,9 Ga Rb-Sr age of biotite suggest that high geothermal gradients were sustained for a long period of time. The ore minerals are dated by Rb-Sr and Pb-Pb methods, which give an ages of 2.15 and 2.0 Ga. Rb-Sr applied to hydrothermal sericite – whole rock pair, yielded an age of 1928 ± 2.6 Ma. The 2.1-2.0 Ga ages could be related to the first stage of mineralization at 600 ºC. The age of 1.9 Ga could be related to the boiling episode that occurs at ~340ºC. Pb, Sr and Nd isotopic compositions of the ore minerals suggest that the hydrothermal fluids represents mixing between several reservoirs, like the mantle, lower and upper continental crust. The metamorphism must have sustained elevated crustal geotherms for at least 100 Ma, promoting hydrothermal fluids circulation during the orogenic time.

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