Investigation of ^{36}Cl distribution in the North-Western Sahara aquifer system

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In spite of its pivotal significance for resource management, the concept of 'groundwater age' remains in many cases elusive. Among various methods proposed for dating groundwater, naturally occurring radioactive isotopes such as ^{36}Cl or ^{81}K and ^{4}He appear as more promising to characterize groundwater transport in the large aquifer bodies where residence times are on the order of 100 kyr to 1 Myr [1-3]. Here, we present new ^{36}Cl analyses obtained on groundwater samples collected in the Tunisian part of the Continental Intercalaire (CI) and Complex Terminal (CT) aquifers that form the North-Western Sahara Aquifer System. These analyses were performed at CEREGE, on the French 5 MV AMS National Facility 'ASTER'. Procedural blanks are routinely measured as less than 1×10^{-16} ^{36}Cl/Cl ratio.

In the Tunisian CT, ^{36}Cl contents up to 12×10^{8} at. l^{-1} are observed while ^{36}Cl/Cl ratios vary from 13 to 75×10^{-15} at at^{-1}. Lower values are generally obtained in the samples collected in the Tunisian part of the CI ([^{36}Cl]< 2.5×10^{8} at. l^{-1}), as expected from their deeper setting. By comparison, the data obtained by Gendouz and Michelot in the Algerian region of the CI show lower ^{36}Cl contents (<3.7×10^{8} at. l^{-1}) but comparable ^{36}Cl/Cl due to lower salinities of the groundwater. The data also show a high heterogeneity in the area of the Tunisian Chotts, probably related to the complex inter-connexions of the aquifer layers in this tectonically fractured basement and/or the complex flowpaths in this area.

The data will be compared to direct predictions obtained from hydrodynamic modelling using MODFLOW implemented with an age-mass calculation subroutine [5], and hydrodynamic parameters and aquifer geometry published previously by Baba Sy [6].

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Pb isotopes and the origin of the 'ghost plagioclase' signature in melt inclusions from the Galapagos Archipelago

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This study looks at olivine-hosted melt inclusions from Santiago and Fernandina islands, Galapagos Archipelago. Although both suites of melt inclusions show plagioclase signature in primitive mantle normalized diagrams, melt inclusions from Santiago show major element composition indicative of plagioclase assimilation. In contrast, the Fernandina inclusions that have the trace-element signature of plagioclase do not show the major element compositions expected during plagioclase assimilation. Thus, the trace-element signature of the original plagioclase is present only as a 'ghost' [1]. Two main hypotheses have been proposed to explain the ghost plagioclase signature, either an ancient recycled plagioclase-rich cumulate intrinsic to the plume [1], or the interaction of melts with plagioclase cumulates within the present day oceanic lithosphere [2, 3]. *In situ* measurement of Pb isotopes in melt inclusions can be used to distinguish between the proposed origins of the ghost plagioclase. We expect that an ancient recycled plagioclase-rich cumulate will have a very different Pb isotopic composition from the present day MORB and FOZO components typical of Santiago and Fernandina lavas [4, 5].

Pb isotopes were measured using the Cameca 1270 SIMS of the Institute for the Study of the Earth's Interior, Okayama University, Misasa, Japan. The 2s errors in our measurements ranged from 0.4 to 2% for ^{207}Pb/^{206}Pb and from 0.3 to 1.6% for ^{208}Pb/^{206}Pb at a range in ^{208}Pb of 219 to 10 cps. The results show that melt inclusions with plagioclase signature have Pb isotopes that are indistinguishable from the present day MORB and FOZO components typical of Santiago and Fernandina lavas. Therefore, the ghost plagioclase signature in Fernandina melt inclusions is produced by melt-plagioclase cumulate interaction within the crystal mush zone beneath Fernandina Island.

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