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Quaternary denudation rates of volcanic islands through cosmogenic nuclides 3He (San Antao island - Cabo Verde)

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Denudation of continental surfaces strongly influences the CO_2 cycle and the climate evolution through chemical weathering of silicate, which consume atmospheric CO_2, and fluxes of sediments which deeply modify the chemical composition of the oceans and bury the organic carbon. In order to better understand the long term carbon cycle and the associated climate evolution, it is important to better quantify the total continental denudation rates and better understand the associated controlling factors. Yet, based on the chemical analyses of rivers, several studies suggest that the present weathering rates of volcanic rocks in tropical area is occurring at higher rates than in other siliceous lithologies. This make the numerous volcanic islands archipelago located in the tropics potentially important sink of CO_2 at the geological time scale. However, their rate of silicate weathering remain unknown at the longer time scale (103-104 a) inhibiting an accurate quantification of the CO_2 consumed at the geological time in these regions.
Cosmogenic analyses on river sediments may provide mean to quantify denudation rates which include both the physical erosion and the chemical weathering. This tool moreover provides basin average of the denudation over long time scale (102-104 a). However, denudation rates measurements have been mainly based on quartz rich lithologies through 10Be analyses. In basaltic and andesitic petrologies, where 10Be cannot be used in an easy and direct way, few studies have been able to measure long term denudation rates. In those lithologies it is however possible to measure the cosmogenic 3He in olivine and pyroxene but very few studies have yet carried out this technique.
In order to quantify the long term denudation rates of a volcanic island in tropical area, and then retrieve the rate of weathering and estimate the amount of CO_2 consumed, we measure the cosmogenic 3He in olivine and pyroxene in 29 river sand samples on all around the San Antao island that is located the Cabo Verde archipelago. This latter represents an excellent natural laboratory to study denudation rates and related processes on volcanic islands. It is located in Northern Atlantic, 500 km from the Senegal coasts and is made of 10 volcanic islands. San Antao is the second biggest island of the archipelago with a relatively homogenous lithology (basanit and nephelinit) and tectonic activity. The island forms a major orographic barrier which creates a precipitation gradient with strong precipitation in NE (>1000 mm/yr) whereas the SW only receives <100mm/yr. This study shall provide, for the first time and using a novel technique, the spatial distribution of the denudation across a volcanic island in tropical area. We expect to observe a broad range of denudation rates related to the rainfall gradient of the island.