Plume-lithosphere interaction at Santiago Island (Cape Verde)

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Santiago Island belongs to the southern group of the Cape Verde archipelago which is implanted in old and thick oceanic lithosphere (140-120 Ma). This paper will address elemental and isotopic data for ≤ 6 Ma Santiago lavas, i.e. those that were formed after the erosive phase which exposed the basal (mainly) intrusive complex.

Santiago samples are ultrabasic alkaline lavas, with Nb and Ta enrichment and significant REE fractionation. Elemental characteristics of primitive lavas indicate complex and variable residual paragenesis including garnet, amphibole and phlogopite. The inferred hydrous residual parageneses are more obvious from geochemical characteristics of recent lavas (< 3Ma), reflecting lithospheric metasomatism by a carbonatitic agent, consistent with their lower Ti/Eu, Sc/Ca, Sm/Sr and Pb/Ce ratios and $a_{(SiO2)}$ values, as well as included carbonate bearing lherzolitic xenoliths. Santiago lavas exhibit a significant isotopic variation ($^{87}Sr/^{86}Sr$ = 0.703177 to 0.703907, ε_{Nd} = -0.4 to 4.5 and ε_{Hf} = 2.5 to 7.2), implying the involvement of HIMU and EM1 like mantle components, in accordance with the overall isotopic characteristics of southern Cape Verde islands.

Given that the evidence for both hydrous residual mantle parageneses and carbonatitic metasomatism are best preserved in the more recent formations, metasomatism should have been developed during previous (> 3Ma) magmatic phases of Santiago building; thus, it is suggested that these features were related to interaction of plume derived magmas with the overlying lithosphere, induced by the intense carbonatite melt reaction/diffusibility through regional lithospheric mantle peridotites. Besides the carbonatitic metasomatic component, the relatively low $^{143}Nd/^{144}Nd$ of Santiago lavas implies an enriched mantle component that must be distinct from typical EM1. This feature strongly suggest the influence of low $^{143}Nd/^{144}Nd$, subcontinental lithospheric derived melts (lamproite – kimberlite) in Santiago magma sources. The data demonstrate the variable role of lithosphere to Santiago magma genesis; thus, endorsing the influence of plume-lithosphere interaction on oceanic island magmatism.

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Impact of the late heavy bombardment on Earth

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The Lunar cratering record is consistent with the occurrence of a late heavy bombardment (LHB), which marked the end of terrestrial planet accretion 3.8 billion years ago. At that moment, migration of the giant planets triggered a cascade of icy planetesimals from the outskirts of the solar system (i.e. ≥ 15 AU from the Sun) to the terrestrial planet formation region [1]. However, clear evidence of a LHB on Earth has not yet been identified. Here we show that the LHB did indeed occur on Earth and that we are breezing its aftermaths. The terrestrial atmosphere and hydrosphere is enriched in noble gases relative to the abundances of volatiles in the mantle. This noble gas composition is a signature of the LHB on Earth and requires a contribution of cold, noble gas-rich bodies formed in the outer solar system. The present day atmospheric composition is consistent with the estimated mass delivered to Earth during the LHB[1] only if it consisted of ~0.5% Kuiper-belt objects mixed in with a population of largely chondritic (i.e. asteroidal) impactors. It seems likely that during the terrestrial LHB, considerable amounts of complex hydrocarbons were also delivered, conceivably providing essential building blocks for the near simultaneous rise of the biosphere

Reference

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