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Noble gases investigation in fluid inclusions of olivines and pyroxenes from Etnean products erupted in the 2001-2004 period

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During 2001-2004 period, Mount Etna has been characterised by an intense eruptive activity which emitted petrologically different products from different vents at the same time. Main eruptions occurred in 2001 (from 2900m and 2100m vents), in 2002-2003 (from North and South flanks) and in 2004, and they involved at least two kinds of magmas with different degrees of evolution. The erupted products have been investigated by analysing He and Ar isotopic composition and abundance of fluid inclusions trapped in olivines and pyroxenes. Helium isotopes showed appreciable differences among products erupted simultaneously but genetically linked to the two different magmas. He isotopic ratios of the more primitive magmas from 2001 lower vents and 2002-2003 South flanks were systematically lower than those from the more evolved one. Moreover, isotopic differences were also observed among olivines of the same parental magma, erupted during the whole 2001-2004 period. The isotopic compositions showed in fact a decreasing trend, with $^{3}He/^{4}He$ ratios moving from 7.05 Ra in olivines fluid inclusions from 2001 upper vent, to 6.6 Ra measured in 2004 products. This behaviour is similar to that observed in the $^{3}He/^{4}He$ ratios measurements carried out during the same period in the free gases discharged at the surface, where the highest isotopic values of the investigated period were measured during 2001 eruption. Also, He and Ar* abundances measured in the olivine-hosted fluid in-

clusions showed a similar trend to that observed for helium isotopes, with the highest content measured in the products from 2001 lower vent and the lowest in those from 2004. This is in agreement with petrological investigations that identified the products erupted from 2001 lower vents as originated from a more primitive and volatile-rich magma, while those from 2004 as originated from a magma that have been stored in the shallow plumbing system during the 2001 and 2002 activity, where it undergoes volatiles loss and an extensive crystallization. He abundances and $^{3}He/^{4}He$ ratios measured in the pyroxenes were systematically lower then in the cogenetic olivines, while argon isotopes showed in any case values next to the atmospheric signature, suggesting a shallow air contamination in the Etnean fluid inclusions, as already observed in previous studies on historical lavas.

The temporal decrease observed in both the helium abundances and isotopic composition of the olivines fluid inclusions of the two product series, as well the small differences between the two series, raise several questions. Although progressive volatiles loss due to magma degassing seems to be a main process, we cannot exclude that contamination can occur by crustal fluids, either in the shallow plumbing system or from the Ionian slab in subduction.