An undeformed ophiolite in the Alps: Field and geochemical evidence for a link between volcanism and shallow plate tectonic processes

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ABSTRACT
Detailed mapping and geochemistry of an undeformed Jurassic ophiolite (Chenaillet-Montgenèvre, Franco-Italian Alps) were performed to document the volcanic architecture at an axial ridge and its relationships with the chemical evolution of basalts and ocean spreading. The architecture of the volcanic cover resembles an abyssal hill with hummocky ridges and hundreds of hummocks, as described at the Atlantic axial volcanic ridge. Mantle rocks and gabbros, below and on both sides of the volcanic hill, are capped with cataclasite horizons representing detachment faults responsible for their exhumation on the seafloor. Basaltic cover and gabbro sills are thin. They overlie a dome-forming mantle basement, the undulated top of which is responsible for the relief variations.

Volcanoes formed on slopes, and the higher the edifice, the younger it is relative to the others. Two types of volcanic architecture, stairs and combs, exist. Stairs are associated with tongue-like volcanoes cascading down the steps. Combs consist of strings of conical volcanoes or hummocks, sitting at the intersections of major fissures parallel to the spreading axis, with oblique subsidiary fractures. Stairs emplaced by rifting of a basement in uplift and already denuded by detachment faulting. Combs formed on a basement in uplift and in the process of denudation along detachment faults serving as magma conduits at depth and as a conveyor belt for volcanoes on the sea floor to a limited extent (<500 m). In both cases, the magma chamber remained beneath the highest part of the relief. In the stairs and combs, rhythmic or continuous compositional variations occurred with time. They attest to cyclic eruptions of primary and differentiated melts, or to extraction of melts as they formed successively. The magma conduits were rooted in ephemeral, small, and frequently recharged reservoirs, or even in the mantle source. Lithospheric tectonics controlled not only magma ascent but also mantle melting.