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Discriminating ophiolitic basalts and their tectonic setting of formation using Th-Nb systematics: The eight-years check-up

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Ophiolites are interpreted to form in a variety of plate tectonic settings including oceanic spreading ridge, ocean island, oceanic plateau, intra-oceanic volcanic arc, continental volcanic arc, forearc, and back-arc. Therefore, ophiolites preserve records of tectono-magmatic events that occurred during distinct phases of development of an oceanic basin and its conjugated continental margins. Recognition of the tectono-magmatic setting of formation of ophiolites is fundamental to resolve major questions of Earth evolution through time, such as how, when, and where ancient oceanic basins formed and consumed. Geochemical fingerprinting of ophiolitic basalts was a fundamental tool in reconstructing ancient oceans as they represent the best record of the Earth's mantle composition and evolution. Since the 1970s, many methods of fingerprinting ophiolitic basalts have been proposed. At the beginning, fingerprinting was mainly performed using triangular diagrams based on immobile elements. Subsequently, there has been a trend towards using binary diagrams plotting elemental ratios, (e.g., Th/Yb, Ta/Yb, Nb/Yb, Zr/Y, Nb/Y); though the use of absolute concentrations (e.g., Ti, V, Y, Cr) has also been proposed. Despite the wide range of fingerprinting methods, most methodologies are not entirely satisfactory either because often failing to correctly classify data, or because considering a restricted number of all possible basaltic types. Some authors proposed basalt fingerprinting based on statistical calculation, which, though very effective, but difficult to be used because of complex calculations. Saccani (2015; http://dx.doi.org/10.1016/j.gsf.2014.03.006) proposed a very simple binary diagram for discriminating ten different ophiolitic basaltic types based on absolute contents of Th and Nb. This diagram was obtained using >2000 ophiolitic basalts (from Proterozoic to Cenozoic) and was tested using ~560 modern rocks from known tectonic settings. Two types of basaltic varieties that have never been considered before were included: a) medium-Ti basalts (MTB) generated at nascent forearc settings; b) Alpine-type mid-ocean ridge basalts showing garnet signature (G-MORB). In this diagram, basalts generated in subduction-unrelated settings can be distinguished from subduction-related basalts with a misclassification rate <1%. Subduction-unrelated basalts show a continuous chemical variation from depleted compositions to progressively more enriched compositions reflecting, in turn, the degree of enrichment of mantle source by plume-type components. Enrichment in Th relative to Nb is dependent on crustal input via subduction slab contamination. Basalts formed at continental margin volcanic arcs can be distinguished from those generated in intra-oceanic arcs (SSZ) with a misclassification rate <1%. SSZ basalts characterized by chemical contribution from subduction-derived components (forearc and island arc tholeiite and boninite) can be distinguished from those with no contribution from subduction-

derived components (nascent forearc MTB and depleted-MORB). Since 2015 many geologists effectively used this diagram; however, since that time the dataset of ophiolitic basalts has increased significantly. Therefore, after eight years a check-up for testing its validity with new data would be certainly welcome. The aim of this contribution is, therefore, to present an eight-years check-up of the Saccani (2005) Th-Nb discrimination diagram.