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THE CENTRAL AMERICAN OPHIOLITES: FRAGMENTS OF INTER-AMERICAN OCEAN FLOOR

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The forearc region of the Central American collision zone between the Cocos and Caribbean plates is characterized by large Mesozoic ophiolite bodies designated by Dengo (1962) as the "Nicoya Complex" and variously interpreted as part of an accretionary prism (Seely et al. 1974, Seely 1979), as an uplifted segment of the trench-slope break (Lundberg 1982), or as an "outer fore arc" portion which was accreted and uplifted due to the subduction of the Cocos Ridge (Shipley et al. 1982). Wildberg et al. (1981) present a model of an island arc evolving on oceanic crust and faulted by horst and graben tectonics. In contrast, Bourgois et al. (1984) proposed a model with nappe formation due to collision tectonics at the Cocos/ Caribbean plate margin. Case et al. (1984) and Howell et al. (1985) summarize the Central American ophiolites as the suspect tectonostratigraphic Nicoya terrane. As the latitudinal paleomagnetic drift path of the ophiolites is close to that of the South American plate (Sick 1989), Frisch et al. (i.p.) favor an autochthonous evolution in an inter-American position similar to the present one.

The Central American ophiolites contain ultramafic rocks, amphibolite, gabbro, dolerite, basalt and plagiogranite associated with radiolarian chert, although a complete uninterrupted ophiolite sequence as described by Coleman (1977) is not preserved. The originally lowermost part consisting of ultramafic rocks, layered gabbros and amphibolites is thrust as a nappe over basalts and radiolarites. Bourgois et al. (1984) distinguish three tectonic units in the northern part of Costa Rica: the Santa Elena, Matapalo and Esperanza nappes. Wildberg et al. (1981) subdivide the Nicoya Complex into two genetically different lithostratigraphic subcomplexes, the Lower and the Upper Nicoya Complex.

We propose after Frisch et al. (i.p.) a subdivision into four lithotectonic units (Fig. 1) based mainly on paleomagnetic data from both magmatic and sedimentary rocks. The Santa Elena Nappe (I) represents the uppermost

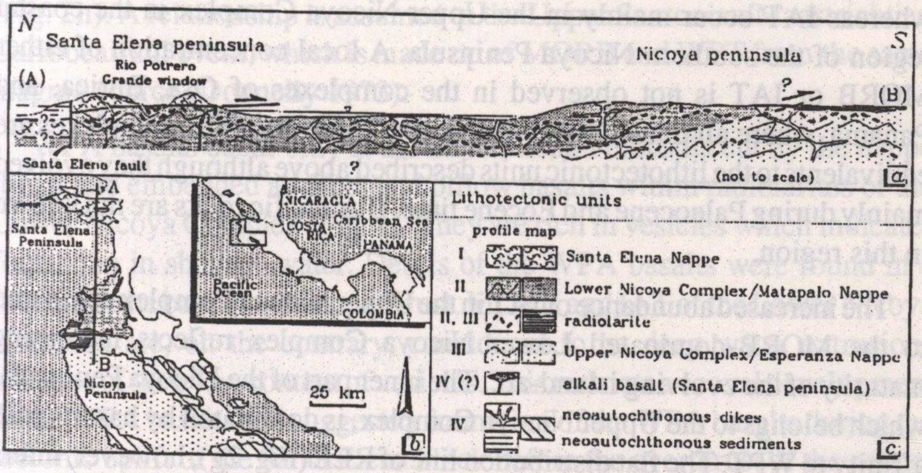

Fig. 1: a: Schematic cross section through the northern part of the Nicoya Peninsula and the Santa Elena Peninsula, Costa Rica. b: Distribution of the lithotectonic units in northern Costa Rica and location of the cross section (geological map from Gursky et al. 1984). c: Legend and lithotectonic units.

tectonic unit. It is overthrust upon the Lower Nicoya Complex (II), which encompasses the basaltic layer of the oceanic crust with a sequence of pelagic sediments in the upper part, mainly represented by radiolarites. Basaltic rocks of the Upper Nicoya Complex (III) penetrate both the Santa Elena Nappe and the Lower Nicoya Complex. The youngest unit (IV) is a neoautochthonous series of crosscutting dolerite dikes and overlying calcareous and clastic sediments.

We studied the geochemistry of the ophiolitic rocks from Costa Rica and Panama. They reflect a complex magmatic history with a great variety of rocks ranging in composition from ultramafic to plagiogranitic (Wildberg 1984, 1987, Berrange and Thorpe 1988, own data). Ultramafic rocks are restricted to the Santa Elena Nappe. Basaltic samples are subdivided into five sets basen on their contents of high field strength (HFS) and rare earth elements (REE) (Fig. 2). They show characteristics of mid-ocean ridge basalts (MORB), usually with slight affinities to island-arc tholeiites, of island arc tholeiites (IAT), and of intraplate basalts (tholeiites, WPT, and alkali basalts, WPA). All basalts are metasomatically altered and therefore enriched in large ion lithophile elements.

Basalts similar to MORB are most abundant in the Lower Nicoya Complex with main outcrops in the northern part of the Nicoya Peninsula whereas IAT occur mainly in the Upper Nicoya Complex in the coastal region of the southern Nicoya Peninsula. A local concentration of either MORB or IAT is not observed in the complexes of Osa, Burica, and Panama, where all transitional types occur. These ophiolite complexes are equivalents to the lithotectonic units described above although they evolved mainly during Paleocene and Eocene time. Ultramafic rocks are not known in this region.

The increased abundance of IAT in the Upper Nicoya Complex compared to the MORB-dominated Lower Nicoya Complex reflects increasing maturity of the evolving island-arc. The inner part of the Nicoya Peninsula, which belongs to the Upper Nicoya Complex, is dominated by basalts with affinity to WPT. The flat distribution line of REE (Fig. 2g), however, infers

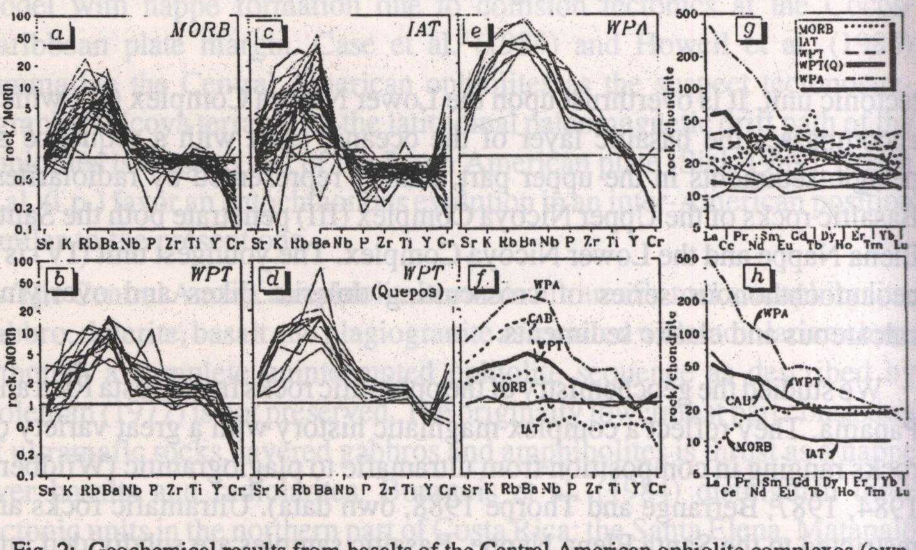

Fig. 2: Geochemical results from basalts of the Central American ophiolite complexes (own data, Wildberg 1984, Berrange and Thorpe 1988). a-e: MORB normalized trace element distribution diagrams showing characteristics of mid-ocean ridge basalts (MORB) (a), within plate tholeiites (WPT) from the Nicoya Peninsula, Osa, and Burica (b), island arc tholeiites (IAT) (c), within plate tholeiites (WPT) from Quepos (d), and within plate alkali basalts (WPA) from the Santa Elena Peninsula (e). Normalization values are from Pearce (1982). f: typical trace element patterns of basaltic rocks for different geotectonic settings (Pearce, 1982). g: chondrite normalized REE distribution diagrams for basaltic samples. h: typical REE patterns of basaltic rocks for different geotectonic settings (Wilson, 1989).

a transitional environment (between normal and HFS enriched MORB) rather than a typical WPT, which should be more enriched in light REE (Fig. 2h). A relationship is aasumed to the Upper Santonian/Maastrichtian Caribbean sill event, which is made up of MORB and WPT from the same magma source (Donnelly 1973).

WPA basalts occur only at the Santa Elena Peninsula cut by the nappe thrust and embedded as dikes and pillow basalts within radiolarites of the Lower Nicoya Complex (Fig. 1). They are rich in vesicles which indicates formation in shallow water. Debris of the WPA basalts were found in a breccia at the base of the nappe thrust. MORB and IAT of the Lower Nicoya Complex are, on the contrary, considered to be deep water extrusions because of their low content of vesicles. This restricts a coeval development of the WPA basalts and suggests a formation of the WPA basalts during the tectonic uplift of the Santa Elena block before the overthrust of the nappe. The WPA basalts probably derive from a deep magma source related to the Santa Elena fault, which is supposed to be of major importance in the regional tectonic framework.

WPT from the Quepos block, also rich in vesicles, display typical characteristics of intraplate tholeiites (Fig. 2g, h) and do not support their interpretation by Baumgartner et al. (1984) as an island-arc fragment of Eocene to Miocene age. We interprete this exotic block as a seamount accreted to the Central American landbridge during the Lower to Middle Tertiary.

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