

Albian to Campanian explosive island arc volcanism in Costa Rica: A new basis for plate reconstructions of western Caribbean

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We present evidence for an Albian to Campanian explosive calc-alkaline island arc volcanism in Costa Rica. The evidence comes from the Loma Chumico Formation, which is an island arc sedimentary succession within the Upper Nicoya Complex. It is composed of radiolarite, clayey radiolarite, siliceous limestone, radiolarian claystone, black shale, and tephra as well as epiclastic deposits. Three main facies of tephra deposits can be distinguished: pyroclastic flows, fallout deposits, and tuffaceous hemipelagic sediments. Tephra deposits principally consist of volcanogenic material but may contain minor amounts of non-volcanic components – radiolarian and pelagic clay. Glass shards are composed by highly vesicular pumice fragments, fragments of broken bubble walls and shards with perlitic cracks. Pumice shards include particles with tabular, subparallel vesicles as well as particles with subspherical vesicles. These features indicate that vitric shards were generated by vesiculation of silicic magma in a subaerial environment. Crystal fragments and phenocrysts comprise plagioclase, quartz, K-feldspar, pyroxene, and minor amounts of hornblende and biotite. Co-magmatic lithic clasts are dominated by acid igneous rocks. The explosive volcanic activity corresponds to a magmatic arc which probably was located in the area of the present Cordillera de Tilarán. The tephra deposits indicate a highly differentiated rhyodacitic magma composition. Although tephra deposits show a calc-alkaline mineralogy and resemble Neogene tephra layers.

The deep-sea sedimentary succession of the Loma Chumico Formation in northwestern Costa Rica is intimately comingled with two different island arc rock units confirming subduction processes:

- 1) A remnant of accretionary prism (Punta Conchal Formation) which consists of several deformed sequences of radiolarites and basalts ranging in age from earliest Middle Jurassic to Cenomanian.
- 2) Basalt series from Nicoya Complex ranging in age from Cenomanian to Maastrichtian. They include boninite type rocks and widespread basalts, which display chemical characteristics of subduction-related tholeiites. These rocks have been considered to represent island arc tholeiites (IAT). However, sedimentological and field evidences, stratigraphic relationships between these units, as well as chemical features permit to interpret these rocks alternatively as a result of an in-situ tholeiitic forearc volcanism.

The Albian to Campanian sedimentary succession

reveals that calc-alkaline volcanic activity was continuous. This in turn leads to the conclusion that the Farallón Plate was equally continuously subducted beneath southern Central America since at least the Albian. In combination with published paleomagnetic data, which prove that the Upper Nicoya Complex was formed in an equatorial position, the volcanic activity recorded by the Loma Chumico Formation points to an in-situ origin of the oceanic crust under the Proto-Caribbean seaway. In addition, paleontological ages of the pre-Campanian accreted sediments permit us to speculate that subduction processes in Costa Rica might have begun already in the Late Jurassic.

Reference:

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