Birth and evolution of seamounts in the Cape Verde archipelago

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Tens of thousands of submarine volcanoes, so-called seamounts, with heights of more than a few hundred meters, exist in the world ocean. The Cape Verde archipelago is of volcanic origin and includes several prominent seamounts, which can give important information on the origin of submarine intraplate volcanism.

The Cape Verde island group is centered on the largest bathymetric swell in the Atlantic Ocean, thought to result from the interaction between the near-stationary Cape Verde Mantle Plume and the African tectonic plate (Courtney and White, 1986). There is a clear age progression of both subaerial and submarine volcanism, with volcano ages of several million years in the east and active (ongoing) volcanism in the southwest and northwest (Holm et al., 2008) (Fig. 1). Thus the oldest islands in the east include Sal, Boa Vista and Maio, and the active island volcanoes in the west are Fogo and Santo Antao.

During the the RV Meteor M80/3 cruise in 2010, we investigated the birth and evolution of seamounts at Cape Verde using bathymetric mapping and detailed sampling with the "ROV Kiel 6000". Prominent extinct and eroded submarine volcanoes in the east include Senghor Seamount, Boa Vista Seamount, Cabo Verde Seamount and Maio Seamount (Fig. 1). Active submarine volcanoes in the west include Cadamosto Seamount (Grevemeyer et al., 2010), Charles Darwin Seamounts, and the newly discovered Sodade Seamount. Young volcanism at Cape Verde occurs at water depths down to about 4000m, and comprises explosive volcanism and emplacement of massive lava flows. The volcanic areas show a very high biodiversity at all depths.

Charles Darwin Seamounts and Sodade Seamount have considerable morphological similarities, as they comprise several volcanic cones covering a roughly circular area on the sea floor (Figs. 2, 3). Both are geologically young, seen morphologically from the several eruption centers that have not yet merged to form a single, large seamount. There is, however, a major difference between the two areas. The most prominent peak at Sodade Seamount is a ca. 1300 m high ridge structure consisting of pillow lavas, suggesting outflow of submarine lavas along a dominant rift zone as the main growth mechanism. Charles Darwin Seamounts, on the other hand, comprises two large craters with a diameter of about 1 km each, formed by explosive volcanic activity at about 3500 m depth (Fig. 3).

Cadamosto Seamount (Fig. 1) is a large mountain, rising from about 4000 m to

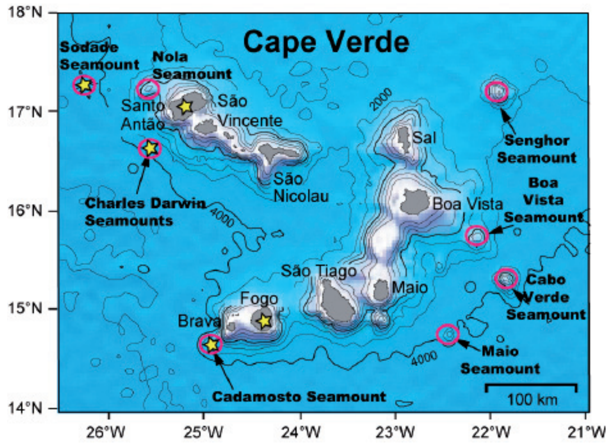


Figure 1: Location of islands and prominent seamounts at Cape Verde. Active volcanoes are marked with a yellow star.

1400 m below sea level. It has a rather unusual phonolitic compostion, suggesting that the magmas responsible for its formation evolved in large magma chambers in the crust. Volcanics from the large explosive Cao Grande eruption on Santo Antao have a very similar chemical composition (Mortensen et al., 2009), indicating that Cadamosto also has a potential for violent eruptions. It is the seismically most active seamount at Cape Verde, and may grow to become the next Cape Verde island (which can take roughly 100.000 years).

The observed age progression at Cape Verde has important geodynamical consequences. First, there is simultaneous magmatic activity in the northern and southern island chains,

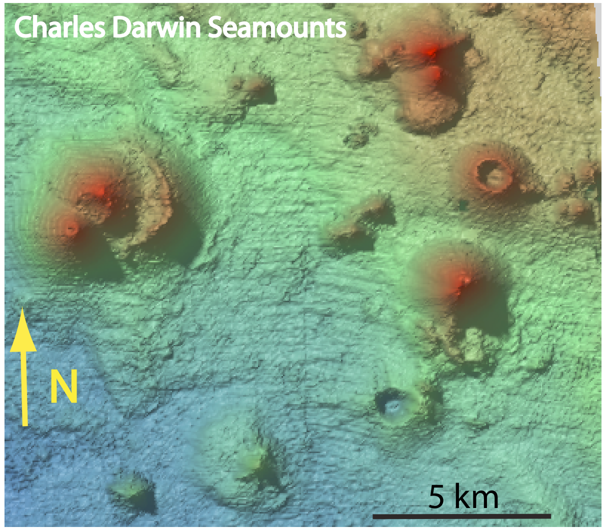
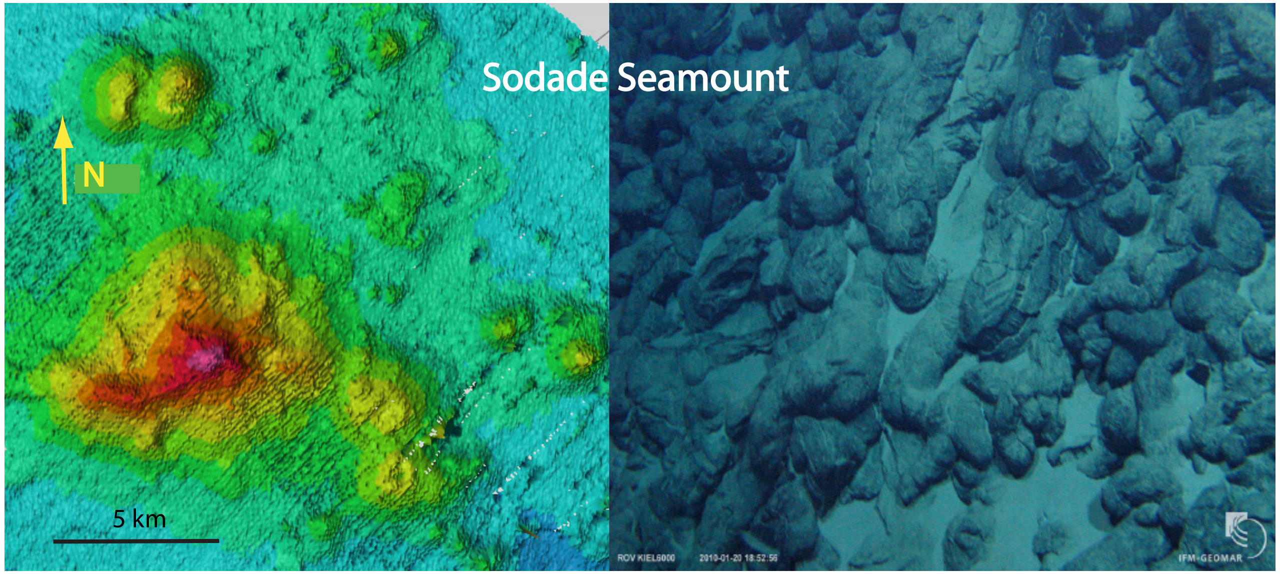


Figure 2: The Charles Darwin Seamounts at about 3500 m water depth off Cape Verde. The two large crater structures in the right half on the picture originated from explosive volcanism at such depths.



reflecting two separate regions of melt formation in the underlying mantle. Second, the general westward age progression is superimposed by a periodic rejuvenation of activity on the eastern rim of the melting region beneath each chain (Fig. 1). Within the southern chain, Fogo Island and Cadamosto Seamount are both active, while Brava Island, located between the two, is less active. In the north, Santo Antao Island, Charles Darwin Seamounts and Sodade Seamount are active, while Nola Seamount, which is located between the three, is extinct or dormant. This scenario may indicate the existence of a pulsating or heterogeneous mantle plume beneath Cape Verde.

References

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Figure 3: The newly discovered Sodade Seamount with its characteristic ridge structure. The right picture shows typical pillow lavas at Sodade (Picture taken with the "ROV KIEL 6000").