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Evolution of the Saint Paul-Amsterdam Plateau in the last 10 m.y.

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The PLURIEL cruise (Marion Dufresne II, 19 September - 31 October 2006) aimed the study of the temporal evolution of the interaction between the St Paul-Amsterdam hotspot (SPA) and the Southeast Indian Ridge (SEIR) over the last 15 m.y. The SPA-SEIR system is an ideal target to study the transition from the intraplate to the axial activity of a hotspot as well as the initial phases of the building of an oceanic plateau. The interpretation of the geophysical data acquired during the cruise, reveal that the time evolution of the ridge-hotspot interaction and the building of the plateau are very complex.

The volcanic chain, located north-east of the SEIR, disappears at about 450 km of the ridge axis and a volcanic plateau begins to form. The plateau was built in different steps, with two ridge jumps and periods of increased magmatic activity, shown by

areas of shallow and smooth seafloor morphology and relatively negative Bouguer anomalies. The crustal thickness varied with time as a function of the evolution of ridge-hotspot distance but also very probably due to temporal variations in the plume flux.

The transition from the intraplate to the axial phases happens at about 8.5 ma, when the hot spot is still positioned off-axis (130 km east of the ridge axis). During this phase elongate volcanic ridges are built off-axis while on-axis, the plateau begins to form, as shown by the establishment of a zone with high and smoth topography. This phase continued, with the gradual increase in the crustal volume produced at the ridge and the reduction of that produced off-axis. Around 6.8 Ma, the hot spot was located very close to the ridge (80 km). Between that period and 5.7 Ma, the axis jumped to the south-west, probably due to an adjustment in the relative motion between Antarctica and Australia, which served as a trigger. A phase with low magmatic budget begins, with the hot spot still located off-axis. During this period, the gradual nearing between ridge and hot spot placed the ridge above the hot spot. However, the volume of crust produced at the ridge remained relatively low. Around 3 Ma, the axis jumped south-westwards to get closer to the hot spot and a new phase of increased crustal production begins. Towards 1.5 Ma the ridge was located above the hot spot. The second magmatic period is marked by an on-axis position of the hot spot. Currently the ridge is situated east of it.

A comparison between the SPA-SEIR system and the Foundation-PAR system reveals that the interaction between the ridge and the hotspot started at roughly equivalent distances. However, in the later case no axial plateau is formed, while here a plateau is built on the early phases of the interaction. This difference may come from the different spreading rates (fast for the PAR, intermediate here). Changes in the spreading geometry such as ridge jumps may interfere with the ridge-hotspot connection and partly explain the beginning of the phase of low magmatic budget. However, the permanence of this low budget during periods where the hot spot was located beneath the ridge axis suggests that during this period, the plume flux was relatively low. Increase in the plume flux may explain the second ridge jump and the second phase of high crustal production.