Geophysical Research Abstracts, Vol. 7, 04847, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04847

Volcanic and tectonic development of the very slow spreading Southwest Indian Ridge near 64°E

R. C. Searle (1) and A. V. Bralee (1,2)

(1) Department of Earth Sciences, University of Durham, DH1 3LE, UK, (2) Present address: Shell International Exploration and Production, Postbus 60, 2280 AB Rijswijk, The Netherlands (r.c.searle@durham.ac.uk)

The Southwest Indian Ridge (SWIR) is accreting at a fairly uniform rate of about 7 km Ma-1 in a N-S direction. We have studied Segment 11 (63.6°E - 64.3°E) using comprehensive bathymetric, gravity and magnetic coverage over the whole segment to 80 km (about 10 Ma) off-axis, and using comprehensive deep-towed sidescan sonar (TOBI) coverage in a 40km x 60 km survey covering half the segment length and extending to 30 km (about 4 Ma) off-axis. These data document an asymmetry and spatial variability in plate accretion processes that are more extreme than those seen for example on much of the faster-spreading Mid-Atlantic Ridge. The segment is at the western end of an E-W section of orthogonally spreading ridge that continues with minor offsets for 600 km eastwards to the Rodrigues Triple Junction. To the west of this segment, the ridge is offset some 15 km to the south in a deep non-transform offset (NTO; maximum depth 5600m), whence it trends WSW through a series of oblique spreading segments to the Melville Fracture Zone at 61°E. The ends of the segment are characterised by a median valley with a relative depth (flank crests to floor) of about 2 km. However, the centre of the segment is dominated by a volcanic massif, Mont Jourdanne, that is some 25 km wide (N - S) and 15 km long (E - W) and completely fills and locally obliterates the median valley. This is one of a number of "super-segments" that are characterised by large volcanic massifs at their centres and large along-axis topographic and mantle Bouguer anomalies, spaced roughly every 200 km along the eastern SWIR and thought to represent more extreme focussing of mantle melt than occurs at the intervening segments (Rommeveaux-Justin et al. and Mendel et al., Mar. Geophys. Res., 19 (6), 1997). Our results show that other massifs, similar to Mt. Jourdanne, occur off-axis. In particular, a pair of massifs occurs at conjugate positions on

the north and south flanks between about 3 and 6 Ma, suggesting this may be about the "return interval" for large focussed-melt emplacement. A small dome-like feature (FUJI Dome) characterised by spreading-parallel bathymetric corrugations occurs in the inside corner of the western segment end, and is interpreted as an oceanic core complex (Searle et al., G-cubed, 4 (8), 2003). We have not reliably identified other similar bodies elsewhere in this segment. The bathymetry shows lineated topography (abyssal hills) throughout the segment, though these lineaments are frequently curved (usually concave to south) rather than precisely linear and, while some appear to be fault scarps, others have less of the character of fault scarps than is common on the Mid-Atlantic Ridge. Often the curved topographic lineaments coincide with curved magnetic anomaly trends, although the current spreading axis is quite straight. The residual mantle Bouguer anomaly (RMBA) is strongly asymmetric, especially within 40 km of the axis where it is up to 50 mGal higher on the south flank compared with the north flank of the ridge, implying over 4 km difference in crustal thickness (thinner to the south). Magnetic anomalies corresponding to the Bruhnes/Matuyama boundary (0.7 Ma) and anomaly 3A (approximately 6 Ma) can be recognised to extend continuously throughout the segment, though their amplitude may be quite variable along the segment. We also recognise anomalies 2A (3 Ma), 3 (5 Ma), 4 (9 Ma) and 5 (10 Ma), but they tend to be discontinuous (either offset or in places apparently missing) along the segment. This variation reflects locally varying accretion rate and extension, which may involve one or more of the following processes: continuous ridge propagation, discontinuous ridge jumps, and variable partition between magmatic accretion and tectonic extension (including detachment faulting at core complexes). The anomalies identified are consistent with a moderately constant average spreading rate of 6.3 + 0.6 km Ma-1 with moderate symmetry (south 8% to 10% faster than north) over the past 10 Ma. The sidescan data reveal more of this variability in accretion. First, a wedge of young volcanic seafloor extends from the segment centre to the west, with its apex in the wall of the NTO. There is a very clearly defined neovolcanic ridge at the centre of this wedge whose axis is straight and runs E - W. By contrast, the seafloor flanking this wedge to north and south appears older, and shows structures (probably both volcanic and tectonic) that trend closer to WSW, as does the ridge axis to the west. This suggests that a recent E - W spreading centre is propagating outwards from Mt. Jourdanne into crust produced at an earlier WSW-trending centre. Similar events in the past may help account for the varying curvature of bathymetric lineations and magnetic anomalies. The sidescan also shows a strong asymmetry in seafloor morphology on the north and south flanks. While the north flank is predominately volcanic terrain cut by small E-W to WSW-ENE faults, the south flank displays much less volcanic terrain and more apparently tectonic terrain, consistent with the thinner crust inferred from gravity. The latter includes some small faults as seen on the northern flank, together with a large (10 km x 20 km) detachment fault at FUJI Dome, several large, steep slopes that may well be faults but are distinct in style from those on the north flank, and a number of areas characterised by short curvilinear features that we provisionally interpret as exposures of lower crust or upper mantle.