Geophysical Research Abstracts
Vol. 17, EGU2015-5460-2, 2015
EGU General Assembly 2015

Stress fields acting during lithosphere breakup above a melting mantle: A case example in West Greenland

Mansour M. ABDELMALAK (1), Laurent GEOFFROY (2), Jacques ANGELIER (0), Bernard BONIN (3), Jean-Paul CALLOT (4), Jean-Pierre GELARD (5), and Charles AUBOURG (4)

(1) Centre for Earth Evolution and Dynamics (CEED), University of Oslo, Norway (m.m.abdelmalak@geo.uio.no), (2) Laboratoire Domaine Océanique UMR 6538, Université de Brest, 29281 Plouzané, France, (0) Géosciences Azur, (3) UMR 8148 CNRS-UPS, Université de Paris-Sud 11, 91405 ORSAY France, (4) Laboratoire des Fluides Complexes et leurs Réservoirs UMR CNRS Total 5150, Université de Pau et des Pays de l'Adour, 64013 Pau, France, (5) Géoscience Le Mans, UMR CNRS 6112, Université du Maine, Le Mans, France.

We characterize and map the stress fields acting during plate breakup along the West Greenland volcanic margin. Interpolated stress fields are based on an inversion of fault-slip data sets and magma-driven fractures, crosscutting mainly an exposed inner seaward-dipping basaltic wedge (i.e. SDRi) segmented along-strike, with differently oriented segments. We identify two distinct tectonic episodes P1 and P2 which are both syn-magmatic and purely extensional. P1 probably acted as early as the Late Palaeocene. This stress field was first homogeneous with the minimum principal stress $\sigma 3$ trending $\sim$N060E, defining a P1A stage. During development of the SDRi, $\sigma 3$ locally reoriented to become orthogonal to each margin segment (P1B). P1 is coeval with lithosphere breakup and is associated with an extension orthogonal to the Labrador-Baffin axis, which is inherited from the Mesozoic. The P1 related dykes constitute an homogeneous HKTP (High-K-Ti-P) suite. This suit displays alkaline affinities and is rich in both LILE and HFSE. A regional and radical change of $\sigma 3$ to a $\sim$NS trend took place during P2. The P1-P2 transition occurred at $\sim$56-54 Ma i.e. during magnetic Chron C24R. P2 is associated with only minor extension and $\sigma 3$ runs parallel to the North American (NAM)/Greenland kinematic displacement vector. The dykes associated with P2 are quite different and constitute a less homogeneous LKTP (Low-K-Ti-P) suite. This suite is less rich in LILE, yielding poorly fractioned chondrite-normalized REE patterns and HFSE contents similar to E-MORB, with slight U-Th and P positive anomalies.
We establish therefore that the minimum horizontal stress $\sigma 3$ for P1 and P2 is parallel to the relative displacement of Greenland related to NAM but not to its absolute displacement during the Tertiary. Taking into account those results as well as variations in magma chemistry from P1 to P2, we suggest that tectonic stresses at a volcanic margin could arise from the local dynamics of the melting mantle.