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Dynamics of conjugate volcanic margins

J.I. Faleide (1), P.A.M. Andriessen (2), W. Jokat (3), M. Scheck-Wenderoth (4), L. Geoffroy (5), J. Hertogen (6), R. Mjelde (7), F. Tsikalas (1) and the NE Atlantic EUROMARGINS Team*

(1) Department of Geosciences, University of Oslo, Norway (j.i.faleide@geo.uio.no / Phone: +47 22856677)

(2) Vrije Universiteit Amsterdam, The Netherlands

(3) Alfred Wegener Institute, Bremerhaven, Germany

(4) GeoForschungsZentrum Potsdam, Germany

(5) Geodynamique des Rifts et des Marges Passives, Université du Maine, Le Mans, France

(6) Fysio-chemische geologie, University of Leuven, Belgium

(7) Department of Earth Science, University of Bergen, Norway

The conjugate volcanic rifted margins off mid-Norway and East Greenland provide the study area for several EUROMARGINS projects focusing on crustal architecture and evolution, quantitative modeling of margin dynamics, and geochemical signature of rift-related volcanism. Within this framework, special emphasis is assigned on: (1) crustal and uppermost mantle architecture (crustal thickness variations, rift polarities, distribution of extrusives, intrusives, magmatic underplating); (2) tectonic and magmatic interplays and styles prior to, during and subsequent to breakup; (3) regional extension and magmatism, including estimates of volume and rates; (4) along-strike segmentation, magmatic and tectonic (a)symmetry, structural inheritance, and (5) interplay of sedimentation, magmatism and vertical motion.

Through collaboration between different research groups we have constructed a series of regional 2D crustal transects across the conjugate margins based on an integrated analysis of deep wide-angle seismic data (OBS and ESP), deep and conventional multichannel seismic (MCS) reflection profiles, potential field data, heat flow, and scientific and commercial boreholes. The transects are extended onshore based

on field work in both Norway and Greenland that includes systematic quantification of surface uplift, denudation and erosion by thermochronology data, and studies of coast-parallel fault systems and associated differential vertical movements. Plate tectonic reconstructions using constraints from our integrated analysis of seismic, gravity and magnetic data, also play an important role in our conjugate margin studies.

The passive continental margin off Norway, and its conjugate off East Greenland, is part of a region which has experienced several post-Caledonian episodes of lithospheric extension. We recognize Late Paleozoic-Early Mesozoic, Late Jurassic-earliest Cretaceous, mid-Cretaceous (Aptian-?Albian) and Late Cretaceous-Paleocene rift structures, and a shift in the central rift zone with time. The latest episode culminated in crustal break-up and accretion of oceanic crust, accompanied by large-scale igneous activity, near the PaleoceneEocene transition. Following break-up, the subsiding mid-Norwegian margin experienced modest sedimentation until the late Pliocene when huge wedges of glacial sediments prograded westward, constituting at least one half of the post-opening sediment volume. A similar outbuilding of Neogene sediments is observed on the East Greenland margin and is related to uplift and erosion of adjacent land areas.

Our data and results also provide important constraints/input to quantitative modeling that is carried out within EUROMARGINS and other research groups. The prime scientific objectives of the modeling efforts are to advance understanding of (1) processes and events during the formation of a volcanic margin, i.e. from onset of rifting to onset of "normal" sea floor spreading; and (2) the processes controlling post-breakup history of a volcanic margin. Both forward and reverse modelling are carried out to explore quantitatively the geological factors controlling the margin dynamics during and after breakup. Furthermore, an important component of our integrated studies is the geochemical signature of rift-related volcanism. Updated petrological and geochemical data are obtained through the thorough re-examination of ODP core samples from both the mid-Norwegian and SE Greenland margins. In conjunction with the other projects, re-interpretation aims to better understand the role of mantle-crust interaction in the early phases of passive margin development.

Key data and results from our ongoing research will be presented and discussed. For details we refer to a series of contributions to the other EUROMARGINS session (SSP11/TS1).