Geophysical Research Abstracts
Vol. 16, EGU2014-3146-1, 2014
EGU General Assembly 2014

Integrated Vitrinite Reflectance and Apatite Fission Track Thermocronology of the Lower Karoo rocks in the Moatize Basin, Tete Province, Mozambique.

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The Karoo in Mozambique is represented by Late Carboniferous to Late Triassic sediments that were deposited in rift basins that fringe or developed between Proterozoic cratons. In Tete Province, central-west Mozambique, the Karoo is well represented along the Zambezi river valley forming several intra-cratonic basins separated by horsts consisting of igneous and high grade metamorphic Proterozoic rocks. One of the main horst blocks is located between the Cahora Bassa region and Tete city, separating the Middle Zambezi Basin and the Lower Zambezi Basin. The area of study is located in the Moatize Basin, one of many small basins that form the Lower Zambezi Basin. The stratigraphy of this basin consists of several sedimentary formations that record changes in depositional environment and palaeoclimate from glacial (Vúzi Formation - Lower Permian) at the base, through wet to temperate in the middle (Moatize Formation - Lower Permian), to warm arid at the top of the succession (Matinde and Cádzi formations - Middle to Upper Permian). The Upper Karoo volcanics of Early Jurassic age do not crop out in the Moatize Basin. One of the most remarkable characteristics of the Moatize Basin is the richness of coal deposits present in the Lower Permian Moatize Formation.

Two coal exploration boreholes (DW123 – T.D. 489 m and DW132 – T.D. 516 m) drilled in the Moatize Basin were studied by means of vitrinite reflectance (VR) and apatite fission track analysis (AFTA), in order to assess their burial and uplift histories. The two boreholes intersected only Moatize Formation lithologies. VR increases in the two borehole sections from ca. 1.30-1.32 % Ro at the top to ca. 1.52-1.69 % Ro at the bottom, indicating medium to low volatile coal rank. Modelled VR data from the two boreholes indicate palaeogeothermal gradients between 40 and 56ºC/km, possible related to basin forming processes. Fission track ages increase from 84 Ma and 102 Ma at the bottom to 138 Ma and 146 Ma at the top of the DW132 and DW123 wells respectively. The Mean Track Length is approximately 11.7±0.2 μm for the four samples studied.

Inverse modelling of both VR and fission track data have been undertaken with QTQt software. The results are consistent for the two boreholes. Thermal histories indicate that samples have been heated to a maximum temperature of 150 to 180 °C following deposition. Maximum temperature was reached at 260 Ma., then a first phase of cooling occurred between 255 and 230 Ma, related to post Lower Karoo exhumation. The sections subsequently cooled very slowly until Neogene time. At 7 Ma, a second, fast cooling episode reduced rock temperatures from 50 – 60 °C to present day temperature. This second cooling episode is possibly related to exhumation caused by the uplift and erosion of the East-African rift shoulders.

The thermal reconstruction indicates that the present coal rank was attained shortly after deposition. Following this burial under a thick sedimentary sequence of approximately 4 km, two main pulse of exhumation affected the Moatize Basin during the Triassic and Pliocene, eroding ca. 2.5 km of Upper Permian strata in the first and 1.5 km in the latter.