Permian palynostratigraphy of Northern Namibia: new data from the Huab, Owambo and Waterberg Basins

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Abstract

Hydrocarbon exploration in Northern Namibia in the last few years has sparked new interest in the Karoo Supergroup geology in the region. Several basins are known, outcropping and covered by Meso-Cenozoic sediments and volcanics.
Recent reanalysis of vintage wells in the Owambo and Waterberg Basins, together with field work and sample collection in the Huab Basin, have provided new data on the Lower Karoo Group stratigraphy in the region.

The historical ST-1 well in the Owambo Basin was resampled, spanning the Dwyka and Ecca Formations/Groups. Three cored wells (OK6-2, OK6-3 and OK9-3) from the Waterberg Basin were sampled, but only spot samples were taken due to the limited vertical span of the Lower Karoo in this area. The Huab Basin outcrops were sampled, both the Ecca equivalent (Verbrandeberg Fm.) and overlying formations (Tsarabis, Huab and Gai-As).

The ST1 well Karoo Supergroup samples showed a low thermal maturation degree (amber-yellow to brown colours) with abundant organic residue.

At the base of borehole ST1, the palynomorph assemblages recovered from the two samples assigned to the Dwyka Group show an abundant and well-preserved palynomorph assemblage, allowing taxonomic identification and biostratigraphic interpretations. These are dominated by abundant trilete spore palynoflora (52–55%), and some Filicopsida vegetation group also occurs. Gymnosperm pollen grains are frequent to rare and are assigned to the Glossopteridophyta group, including the monosaccate pollen (ca. 10%). Taeniate bisaccate pollen grains (13-14%) are common. Polyplicate pollen grains are also present (9-10%). In addition, non-marine algae groups are rare to frequent (6–14%), including *Botryococcus braunii*, *Leiosphaeridia* sp., *Ovoidites* spp., and *Tetraporina* sp..

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This assemblage, assigned to the Dwyka Group, is characterised by the common occurrence of spores and monolete pollen grains, with *Vittatina* spp. and the presence of the FO and LO of *Hamiapollenites bullaeformis*, suggesting an early Permian, Cisuralian, Asselian/Sakmarian age.

The assemblages recovered from samples assigned to the Ecca Group in ST-1 are dominated by trilete spore palynoflora (44–90%). Gymnosperm pollen grains are rare and are assigned to the Glossopteridophyta group, including the monosaccate pollen (ca. 1-10%). The rare non-taeniate bisaccate pollen grains are rare (ca. 0.6-1.5%). Rare Taeniate bisaccate pollen grains (of about 2-8%) are also rare in the assemblage. Rare to common polyplicate pollen grains (3-28%) are observed. Non-marine algae are rare to common (3-20%), similar to the deeper samples, while the fungi group is represented by *Portalites gondwanensis*.

The assemblages recovered in samples OK6-2 and OK6-3 are assigned to the Ecca Group and present a very poor spore assemblage. In borehole OK9-3, the Ecca assemblage is dominated by trilete spore palynoflora, with the Filicopsida vegetation group dominating. Gymnosperm pollen grains are rare, and Lycopsida microflora is common. Rare Taeniate bisaccate pollen grains occur in the assemblage with rare polyplicate pollen grains. Non-marine algae are rare to common and similar in composition to the ST-1 well samples.

Samples from the Huab Basin were mostly barren. The upper part of the sequence - Tsarabis and Gai-As Fms. – are composed of continental to transitional sediments, hampered organic matter preservation in most instances. The Verbrandeberg Fm. samples provided poorly preserved and poorly diversified sporomorph assemblages, indicating an Early Permian (probably Artinskian) age, following the regional interpretation for the Ecca unit. The sedimentation environment was lacustrine, as indicated by the presence of phytoclasts (vastly dominant), spores and, to a lesser degree, pollen. Non-marine algae – *Botryococcus* sp and *Tetraporina* sp. – support a lacustrine setting interpretation.

Abundant spores and a marked reduction of pollen grains characterise the Ecca palynology assemblages. The FO of abundant *Lundbladispora* spp. (even in tetrads) is a key taxa reference suggesting an Artinskian age.

Both assemblages contain key-species *V. costabilis* which is recognised as a late Carboniferous to early Permian marker, more abundant during the early Cisuralian (Asselian to Artinskian).
In these continental successions, the absence of independent age constraints hampers the long-distance correlation of the Northern Namibia basins with other Karoo basins and other regions of the Gondwana paleophytogeographical province. However, similar assemblages can be identified at a sub-regional scale (northern Namibia, possibly Botswana and Paraná Basin), which can be used for correlation purposes and support regional exploration efforts.

Keywords: Permian, Namibia, Palynology