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Timing of Permian rifting in the Saih Hatat Dome (Sultanate of Oman)

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The Saih Hatat Dome (SHD) in NE Oman forms a tectonic window revealing in an area of approximately 95 km by 50 km the par-autochthonous Neoproterozoic basement of the Arabian Plate and its Cambrian to Early Cretaceous cover. The SHD is surrounded by the allochthonous Samail Ophiolite and underlying nappes consisting of mostly sedimentary rocks from the Neo-Tethyan Hawasina Basin.

Within this dome, the Hulw Window exposes rocks that were subducted to depths of >30 km during the Late Cretaceous (Agard et al. 2010) and were subsequently exhumed and tectonically emplaced beneath low-grade metamorphic rocks, forming what is referred to as the "Lower Plate". The Hulw Window consists of marbles, metadolostones, and calcareous micaschists, with embedded mafic and felsic metavolcanic rocks. The entire Hulw unit underwent Late Cretaceous high-pressure/low-temperature metamorphism.

Earlier studies assumed Pre-Permian ages for the protolith for the metamorphic rocks of the Hulw unit (e.g. Miller at al. 2002). Newly obtained U-Pb zircon LA-ICP-MS data from felsic metavolcanic rocks yield ages of 283 ±2.9 Ma and 269 ±3.7 Ma, indicating an Early to Middle Permian volcanism.

Two blueschist-facies quartzites from the southern Hulw unit contain concordant detrital zircons, ranging in age between c. 530 and 2872 Ma with age clusters around 750 to 850 Ma and 1010 to 1164 Ma. The latter ages are not known from an Arabian source and might be derived from an Indian source. The maximum depositional age of the sediments is therefore Early Cambrian.

Field studies in the central part of the SHD revealed numerous mafic dykes, some reaching widths of up to 4 m. These dykes are oriented WNW-ESE and NE-SW. Zircons from one dolerite dyke yields an age of 267 ± 3.7 Ma, indicating that the mafic and felsic magmatism occurred simultaneously.

Whole-rock geochemical data of the mafic volcanic rocks demonstrate a significant partial melting trend, suggesting an increasing degree of upper mantle melting. The felsic metavolcanic rocks are classified as subalkaline to mildly alkaline rhyodacites, which are derived from crustal melting typical of early rift stages.

Overall, the SHD displays a progressive increase in Permian subvolcanic and volcanic rocks from the southeast toward the northwest, characteristic of rift-related crustal extension. This extension ultimately led to the opening of the Neotethys and the separation of the African/Arabian Plate from the Central Iranian/Qiantang blocks and the Indian Plate at a triple junction (Torsvik et al. 2014).

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