Core-Log -Seismic Integration for the Cretaceous to Oligocene sequence in the African-Southern Ocean gateway: First results from the Agulhas Plateau (IODP Sites U1579 and U1580)

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Climate models have identified significant geography-related Cenozoic cooling arising from the opening of Southern Ocean gateways (e.g., Sauermilch et al., 2021). For example, a gradual strengthening of the Antarctic Circumpolar Current (ACC) has been proposed as the primary cause of cooler deep ocean temperatures associated with the transition from the Cretaceous "Supergreenhouse" to the Oligocene icehouse (e.g., Sijp et al., 2014).

IODP Expedition 392 'Agulhas Plateau Cretaceous Climate' drilled four sites in the African-Southern Ocean gateway in 2022 to significantly advance understanding of how temperatures, ocean circulation, and sedimentation patterns evolved as CO_2 levels rose and fell and Gondwana broke up (Uenzelmann-Neben et al., 2022). Prior to Exp. 392, seismostratigraphic models developed for the African-Southern Ocean gateway relied solely on age data from remote drilling sites and information from piston cores, gravity cores, and dredge samples. As a result, a high level of uncertainty had to be assumed for reflector age information, particularly for the sparsely sampled pre-Miocene sedimentary column.

We here present preliminary findings from a revised seismostratigraphy based on core-log-seismic integration at Sites U1579 (central Agulhas Plateau) and U1580 (southern Agulhas Plateau), both of which are located at the heart of the African-Southern Ocean gateway. Core density and velocity data were edited, corrected to in-situ conditions, and combined with downhole logging data. Synthetic seismograms provide an accurate traveltime to depth conversion and show an excellent correlation of drilling results with the site survey seismic field records.

A first correlation of the seismic reflection data with the preliminary shipboard bio- and magnetostratigraphy reveals that the published seismostratigraphic models are erroneous and need revisions, for example, a reflector interpreted to represent a lower Eocene sea level highstand on the Agulhas Plateau has now been identified as the Cretaceous/Paleogene (K/Pg) boundary. Further prominent reflectors can be associated with the Eocene-Oligocene transition (EOT), the top and bottom of zeolitic siliciclastic sandstones (Santonian) and intra-basalt reflections, interpreted as sills.

The core-seismic correlation allows tying major changes in other physical properties (e.g., colour reflectance, natural gamma radiation), chemical composition (e.g., major element ratios from XRF core scanning) and sedimentological parameters (e.g., grain size) to the seismic grids, which will aid reconstructions of oceanic circulation changes and magmatism variations in relation to the development of the Agulhas Plateau.

References:

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