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Orbital forced cyclicity in the depositional environment in the Cape Basin?

An integrated study of borehole and seismic data

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The southern hemisphere's response to significant changes in global climate is still poorly understood. A clue can be offered by the study of sedimentary sequences along the continental margin off southwest Africa. The depositional structures were shaped by an interaction of climate, oceanic currents and sea level fluctuations. The region lies under the influence of the Benguela Current Upwelling System (BCUS), which is one of the major upwelling systems worldwide. Due to its high sedimentation rate this area is favourable to study climate influences on sedimentation in a fine scale.

We present a seismostratigraphic model for the Neogene and Quarternary sedimentary layers in the Cape Basin based on a combination of reflection seismic lines with drill site records of the ODP Leg 175 sites. The drill site data were converted from depth domain to two-way traveltime domain by sonic logs calculated from P-wave velocities of the site data. This procedure enables dating and areal tracing of reflectors mirroring changes in deposition system concerning the composition of the sediments as well as changes in currents and deposition style.

For the middle and northern Cape Basin our study reveals an apparently regular sequence of continuous high amplitude reflectors characterizing the upper seismic units. They are well pronounced for about the last 3.5 Ma. The computed spectra of depth and age over the strong amplitude reflectors indeed indicate a certain periodicity. Periods of 95 to 120 cycles/ky dominate especially the undisturbed sequences close to Sites 1082, 1083 and 1084. As a reason for the regularity of reflectors we suggest glacial to interglacial cycles as they present climate thresholds at which sediment composition drastically changes. These changes also influence density and P-wave

velocity of the deposits and, consequently, find their expression in impedance contrast and thus in the seismic reflection pattern. Considering a certain inaccuracy of depth and hence of age determination for the seismic reflectors, we suggest these cycles to coincide with obliquity cycles of the earth's orbit.

In the southern Cape Basin however, we cannot observe such a distinct cyclicity of reflectors throughout the last 15 Ma. Here, the frequency and sequence of reflectors is much lower and shows only a weak maximum around the period of 400 ky. In this region a much lower sedimentation rate probably prevents the resolution of a fine scale reflector sequence. Additionally, the deposition sequence seemed to be disturbed by mass movements as indicated in numerous slump scarps recorded on the seismic lines.