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The influence of inherited structures on dyke emplacement during Gondwana break-up in southwestern Africa

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A kinematic analysis of Cretaceous and pre-Cretaceous faulting and fracturing was carried out along the west coast of Southern Africa extending from the greater Cape Town area to the Orange River and beyond into southern Namibia. This study was augmented by the geometric analysis of mainly Cretaceous mafic dykes exposed from SW Angola to the southern tip of Africa. The kinematic analysis shows that the Cretaceous rifting event that led to the opening of the modern South Atlantic was largely controlled by NW-SE and NE-SW-striking structures. In the coastal areas of South Africa the Cretaceous deformation was dominated by NE-SW extension, whereas a general E-W-oriented extension prevailed further north. Analysis of reverse and strike-slip faulting in the Gariep and western Saldania Belts shows that the Pan-African constrictional deformation in South Africa was mainly controlled by ENE-WSW- to ESE-WNW-oriented shortening. Further north, the geometry of the Odgen Rock Mylonites in Namibia is controlled by N-S-striking strike-slip faults.
The geometric analysis of the orientation of the mafic dykes also points to an E-W-oriented extension direction in the coastal areas extending from southern Angola to Meob and Conception Bay in west-central Namiba and changes to a generally NE-SW-oriented extension along the west coast of South Africa. Further inland in the Damara Belt sensu strictu, the geometric analysis of dykes belonging to the Hentjes Bay-Outjo Dyke Swarm also indicates NE-SW-oriented extension but, in addition, also a strong component of NW-SE-directed extension controlled dyke emplacement.
The results of this study suggest that Pan-African (or older) structural discontinuities were re-utilised during the opening of the South Atlantic in the Early Cretaceous. The extension directions associated with Cretaceous Gondwana break-up structures are subparallel to the Pan-African shortening orientations. The inherited structural anisotropies are generally parallel to major lineaments and/or shear zones that, in turn, follow the trend of older mobile belts and/or are parallel to Archaean and/or Proterozoic craton boundaries. Consequently, the inherited Pan-African and/or older structures provided lithospheric anisotropies that controlled the Cretaceous rifting of SW Gondwana and the opening of the modern South Atlantic.