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Palaeointensity and palaeodirection determinations of Paleoproterozoic dykes in the Kaapvaal Craton (South Africa)

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A combined palaeodirectional and palaeointensity study of a representative collection from the Bushveld Igneous Complex from 27 dolerite dykes from the 2.9, 2.7, and 1.8 Ga age swarms radiating SE, E and NE, respectively [Olsson et al., 2010] was carried out. Conventional progressive thermal or AF demagnetization was applied to all specimens. The palaeomagnetic directions have been calculated after thermal demagnetization. The ChRMs were isolated over the temperature interval 440-590 C and their intensities amount to 95% of total NRMs. Paleopole calculate from the primary high-temperature component, separated in the 2.9 Ga SE-dykes, is close to the paleopoles, obtained by Wingate (1998) and Strik et al. (2007) for 2.78 Ga volcanics. The paleopole calculated for the 2.7 Ga age E-trending dykes of the eastern region does not correspond to any of the previously obtained Archean-Paleoproterozoic paleopoles for the Kaapvaal Craton. The paleopole calculated for some NE-trending dykes of the Black Ridge swarm in the NE region is close to the 1.87 Ga pole of the Kaapvaal Craton obtained by Hanson et al. (2004).

Palaeointensity determinations were carried out on rocks from ten dykes of different ages using Thellier-Coe method with the "check-points" procedure on specimens of 1 cm in edge length cut from either drilled cores or hand samples. Rock magnetic measurements were made on sister specimens. Curie temperatures and the thermal stability of magnetic minerals were estimated from thermomagnetic heating-cooling cycles to incrementally higher temperatures T_i with a Curie balance in an external magnetic field H = 0.45 T. To assess the magnetic hardness and mineralogy of samples, measurements of magnetic susceptibility and hysteresis loop parameters were performed. The domain structure (DS) was estimated also from the thermomagnetic criterion by evaluating the tails of pTRMs. Wilson's method of palaeointensity determination based on comparison of thermodemagnetization curves of NRM(T) and TRM(T) was used too. Reliable palaeointensity determinations were obtained on only the site N28 of the age 1.85 Ga (Olsson et al., 2010). The rocks from this site demonstrated extremely stable magnetic properties to heating, their Curie points are closed to Tc of the magnetite. The thermodemagnetization curves NRM(T) and TRM(T) are very similar and the positions of check-points on the Arai-Nagata diagrams are close to the initial pTRM values. Seven samples (12 sister cubes) showed very similar intensities of paleofield H_{anc} lying in the interval 15-23 μT, with the mean VDM = 2.85 Amˆ2. This result agrees with the widespread opinion that the field in the Paleoproterozoic was considerably less than the modern magnetic field.