

Magnetic study of jaspers of the Fig Tree Group from Barb4 drill core

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We report new results of magnetic tests performed on jaspers of the 3.25 Ga Fig Tree Group from Barb4 drill core (Barberton Scientific Drilling Project – South Africa). Thermal demagnetization of IRM (isothermal remanent magnetization), achieved at the University of Cergy-Pontoise in France, shows that our jaspers contain pyrrhotite or geigrite (Curie temperature (CT) is $\sim 320^\circ\text{C}$), magnetite or maghemite (CT is $\sim 580^\circ\text{C}$), and more importantly hematite (CT is $\sim 680^\circ\text{C}$). Demagnetization of NRM (natural remanent magnetization), performed at the University of Johannesburg in South Africa, indicates that all specimens (~ 60 oriented cores) have high NRM values (in order of 10^{-3} and 10^{-4} A/m), but only respond to “cleaning”, and thermal treatments below 500°C ; specimen heating above this step results in erratic behavior, i.e., systematic increase, and change in plot trajectory of remanence values. This observation is in contrast of what one would expect from rocks containing hematite. It, however, seems to agree with results of frequency dependent MS (magnetic susceptibility) achieved at the Council for Geoscience at Pretoria in South Africa, which suggest that most hematite grains in our jaspers are too fine in size and magnetic domain (i.e., $<0.03\mu\text{m}$) to carry magnetic remanence. These grains are rather superparamagnetic as their MS decrease with increasing frequency (MS is $\sim 2.04 \times 10^{-3}$, $\sim 2.02 \times 10^{-3}$, and $\sim 1.99 \times 10^{-3}$ for frequency of 976, 3904, and 15616 Hz respectively). Furthermore, test of temperature dependent MS, also achieved at the Council for Geoscience, demonstrates that the fraction of ferromagnetic hematite of our jaspers is not transformed to a new magnetite or maghemite phase as consequence of heating (curve peak at run $\sim 580^\circ\text{C}$), and that new, strongly magnetized pyrrhotite or geigrite phase forms during subsequent cooling (curve peak at run $\sim 320^\circ\text{C}$).