Constraints on paleointensities during Archean obtained from komatiites of the Barberton and Belingwe greenstone belts

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In order to reexamine the oldest paleointensity data given by Hale (1987), ca. 3.5 Ga komatiites were collected in the Barberton greenstone belt, South Africa. Komatiites with a much younger age of ca. 2.7 Ga were also sampled in the Belingwe greenstone belt of Zimbabwe, to make a comparison between two greenstone belts. By Thelliers' experiments, mean apparent VDM values corresponding to the intensities of about 23% and 15% of that of the present field were obtained from the samples of Barberton and Belingwe, respectively. However, SEM observations clarified that magnetites in the samples are secondary minerals formed during serpentinization, and that the ChRMs of the samples are grain growth CRMs. Therefore, these weak values provide lower limits of the actual field intensities.

The intensity of the geomagnetic field during Archean is an important source of information about the dynamics of the Earth's core. Hale (1987) reported the very low equatorial paleointensity value of 5 micro T obtained from komatiites with an age of 3.5 Ga of the Barberton greenstone belt, South Africa, and suggested that there was a sharp increase in magnitude of the geomagnetic field between 2.7 and 2.1 Ga, linking it to the onset of the inner core nucleation. However, a compilation of reliable paleointensity data by Prevot and Perrin (1992) hardly recognized such a drastic increase, and they pointed out the fact that the remanences of the rocks used by Hale (1987) might be carried by magnetite formed during serpentinization, which resulted in the secondary chemical remanent magnetization (CRM).

In order to reexamine the oldest paleointensity data given by Hale (1987), ca. 3.5 Ga komatiites of the Komati Formation were collected in the Barberton greenstone belt, South Africa. Komatiites with a much younger age of ca. 2.7 Ga were also sampled in the Belingwe greenstone belt of the Zimbabwe craton, to make a comparison between two greenstone belts. Paleomagnetic directions obtained from the samples of the Barberton greenstone belt closely agree with the results from the same formation previously reported by Hale and Dunlop (1984). For the samples from the Belingwe greenstone belt, the positive large-scale fold test indicates that their ChRMs are pre-folding magnetizations. Thermomagnetic analyses and hysteresis measurements show that the main carriers of the remanence of komatiites from both greenstone belts are partially maghemitized magnetite, whose typical grain size is in the PSD state.

By Thelliers' experiments, mean apparent VDM values corresponding to the intensities of about 23% and 15% of that of the present field were obtained from the samples of the Barberton and Belingwe greenstone belts, respectively. However, SEM observations clarified that magnetites in the komatiite samples are secondary minerals formed during serpentinization, and that the ChRMs of the samples are grain growth CRMs. Therefore, these weak values provide lower limits of the actual field intensities, suggesting the presence of much larger geomagnetic field intensities at ca. 3.5 Ga and 2.7 Ga than that of the obtained VDM values.