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Normal and reverse remanence directions isolated in basaltic to andesitic dykes - self-reversal magnetization or a reversal record of the geomagnetic field?

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Detailed rockmagnetic analyses were performed on basaltic to andesitic dyke samples from the Lhasa Block previously used for paleomagnetic investigations of the India-Asia collision. Both, normal and reverse remanence directions probably residing in Ti-rich titanomagnetite were isolated within single sites. The main issue is to find out whether these antipodal directions are due to different polarities of the geomagnetic field or due to a self-reversal process. Ti-rich and Ti-poor titanomagnetites were identified in most samples by their corresponding Curie temperatures in high temperature thermomagnetic runs. Reflected light microscopy, domain pattern observations and EDX analyses verified two different generations of titanomagnetite grains: Larger (about 20 to more than 100 μm) inhomogeneous grains of Ti-poor titanomagnetite and smaller (less than 10 μm) rather homogeneous grains represented by Ti-rich titanomagnetite. Both magnetic components are spatially separated without any contact which makes magnetostatic or superexchange interactions unlikely. Furthermore, partial thermoremanence experiments showed that there is no important magnetic coupling of the two phases. A possible interaction between non-oxidized and oxidized Ti-rich titanomagnetite is improbable as the grains are rather unaltered and rock magnetic analyses indicate only one Ti-rich titanomagnetite phase. Low temperature dependence of isothermal remanent magnetization and saturation magnetization clearly disproved an N-type behavior of the samples. Self-reversal due to ionic reordering would require a high degree of maghemitization of the Ti-rich titanomagnetites which was not observed. In summary, a self-reversal magnetization is very unlikely in the studied samples and the observed antipodal directions likely are a consequence of one or more reversals of the geomagnetic field during remanence acquisition. This implies that the time of remanence acquisition was long enough to average out paleosecular variation which supports the reliability of the paleomagnetic data.