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Paleomagnetism of the ∼1.1 Ga Coldwell Complex (Ontario, Canada): Implications for Proterozoic geomagnetic field morphology and plate velocities

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We conducted a detailed paleomagnetic study of the ∼1108 Ma intrusive Coldwell Complex (Ontario, Canada) to investigate the apparent reversal asymmetry observed in some Midcontinent Rift (MCR) rocks. The rocks of eastern and central part of the Coldwell Complex are reversely magnetized with a group-mean direction of D=114.8º, I=-63.7º (α95=3.6º, N=30). The corresponding paleomagnetic pole at Plat=47.2ºN, Plong=206.5ºE (A95=4.8º) is located close to the paleomagnetic poles from nearly coeval reversely magnetized rocks of the MCR system, including the lower lava flows of the Mamainse Point sequence. The rocks of western part of the complex are normally magnetized with a group-mean direction (D=298.0º, I=56.9º, α95=5.8º, N=10) that passes the reversal test with respect to the reversed group-mean direction. The corresponding mean pole (Plat = 44.9º N, Plong = 193.2º W, A95 = 8.0º, K = 37) is statistically similar to the pole from the lower normally magnetized section of the Mamainse Point sequence, but is distinct from the normal polarity paleomagnetic poles representing the main stage of MCR activity. Our results do not support the previous model in which the complex was emplaced during two periods of reversed geomagnetic field polarity separated by a period of normal polarity, and hence encompasses two geomagnetic reversals. Instead our new data indicate that the Coldwell Complex records only two polarity intervals separated by a symmetrical reversal at ∼1102-1105 Ma. This reversal is likely equivalent to the lowermost reversal recorded at Mamainse Point and provides further evidence that the apparent reversal asymmetry reflects a plate motion rather than a persistent non-dipole field geometry. Together with a high-quality data from the ∼1098 Ma North Shore Volcanics, our data indicate a rapid velocity of Laurentia at a rate of ∼25±4 cm/yr. The fast plate motion may reflect a decreased mantle drag due to vigorous mantle indicated by widespread intraplate magmatism at ∼1.1 Ga.