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Are martian crustal magnetic anomalies and valley networks concentrated at low paleolatitudes?

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A broad spatial correlation between the Mars crustal magnetic field and the distribution of valley networks has previously been reported. Several possible explanations involving magmatic instrusions, hydrothermal alteration of the adjacent crust, and surface discharge of water have been suggested. In this paper, we investigate whether the distributions of both magnetic anomalies and valley networks may have been preferentially concentrated at low paleolatitudes. Such a concentration would be expected if melting of water ice and snow was a stronger source of surface valley erosion in the tropics and if hydrothermal alteration of crustal rocks played an important role in producing the unusually strong martian magnetic anomalies. To estimate the location of the paleoequator during the epoch when crustal magnetization was acquired, we adopt the results of forward modeling of major martian magnetic anomalies. These modeling analyses yield an estimated paleopole position at $34^\circ \pm 10^\circ$ N, $202^\circ \pm 58^\circ$ E. A visual comparison of the observed distributions of valley networks and crustal magnetic anomalies with the calculated paleomagnetic equators shows that the mean paleomagnetic equator tends to follow these distributions. However, the mean tilt angle relative to the equator of the magnetic anomaly distribution ($\sim 45^\circ$) is somewhat greater than that of the valley network distribution ($\sim 15^\circ$ - 30°). In order to objectively compare the paleopoles that are predicted by the hypothesis investigated here, we calculate the standard deviation in km of the latitudinal displacements of valley networks from the paleoequator corresponding to a given assumed paleopole location. The most probable paleopole location based on the magnetic field magnitude data ($\sim 67^\circ$N, 201°E) is near to that estimated from the directional modeling analyses. The valley network data yield a most probable paleopole location at $\sim 75^\circ$N, 222°E.