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New constraint of the Martian dynamo from surface magnetic survey by Zhurong rover

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The timing of the martian dynamo has always been an outstanding scientific issue in the evolution of Mars, as it provides the key implications for the evolution of the Martian core and the habitability. Both an early dynamo before ~ 4.1 Ga (e.g., Acuña et al., 1999), a late dynamo after 3.9 Ga (e.g., Mittelholz et al., 2020), and even a long-lived dynamo (Steele et al., 2023; 2024) have been suggested to interpret the martian magnetism at large scale by orbiting measurements and at very small scale via Martian meteorites. The dynamo status after early Hesperian (e.g., ~ 3.7 Ga) is still poorly constrained. Here we report surface magnetic survey in the southern Utopia basin from Zhurong rover. In addition to the extremely weak magnetic fields inside a ~ 6 -km diameter ghost crater in the first 800-m track, the magnetic intensity exhibits a significant enhancement (~ 40 nT on average) in the following 600-m track at the edge and outside the crater. A magnetic source with depth of about 600-m and average magnetization of ~ 1 A/m are required to produce the measured field strength outside the crater. Such magnetic source is likely carried by Hesperian lava flows. The presence of the moderate and little magnetizations outside and inside the ghost crater indicate the martian dynamo may have persisted until mid-Hesperian but experienced a significant decrease before the ghost crater was formed.