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Rock magnetic characteristics of loess -soil series in Tajikistan (based on materials from the study of the reference section Khonako-II)

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Introduction: The loess-soil sections of Tajikistan constitute a unique paleogeographical archive, providing information about the glaciations and interglacial periods of Central Asia. The studied site is the loess-soil section of Khonako-II (38.359268°N, 70.046344°E), located near the village of Khovaling in the Khovaling district. This study presents the results of rock magnetic research on the upper part of the section (first 20 meters), corresponding from Holocene to Marine Isotope Stage 5 (MIS 5).

Methodology: Rock magnetic analysis involves measuring the frequency and temperature dependence of magnetic susceptibility, its anisotropy, natural remanent magnetization, as well as hysteresis experiments to study saturation remanent magnetization, coercivity remanence, and other parameters. The Kappabridge MFK1-FA was used for measuring the frequency dependence of magnetic susceptibility (Kfd) at low (976 Hz) and high (15616 Hz) frequencies. A total of 500 samples were measured (every 4 cm).

The Kappabridge MFK1-FA was also used to measure the temperature dependence of magnetic susceptibility (kT). A pilot collection was measured: 5 from the Holocene soil, 5 from the first loess horizon, 5 from the first pedocomplex. Additionally, the Kappabridge was used to measure the anisotropy of magnetic susceptibility (AMS).

Coercivity spectrometer (J-meter) (Jasonov et al., 1998) was used to measure characteristics of isothermal magnetization and coercivity. 192 samples were investigated under continuous growth of the external magnetic field (at the maximum field of 1,5 T).

Results: Correlation of the magnetic susceptibility pattern with the marine isotope stage (MIS) record, age constraints were established for the upper part of the reference section Khonako-II. Specifically, the first pedocomplex was correlated to MIS 5 with an age of 100-130 thousand years.

According to thermomagnetic analysis, magnetite is the main magnetic mineral The Curie temperature for all samples is about 580˚C; however, the samples are not completely demagnetized, confirming the presence of the hematite t.

The predominant wind directions were obtained by the base of AMS data. The main wind directions for both the first loess horizon and PC-1 are NNW-SSE and NNE-SSW wind directions.

By the results of rock magnetic research, 11 stages of sediment accumulation and environmental development were identified within the first 20 meters of the section. We identified a Holocene soil, a loess horizon containing 2 small periods of warming (corresponds to MIS 3) and the pedocomplex consisting of 2 paleosols and corresponding to the stages of MIS 5c and MIS 5e. The contribution of the paramagnetic component to the total magnetization (Kpar/Kint%) ranges from 4 to 23%. There are two intervals of increasing paramagnetic signal in the lower part of the soil (1720-2040) and in the middle part of the loess (520-820). In the last interval, the concentration of paramagnetic grains sharply increases - apparently these are paleopic MIS 3, which is not distinguished according to the results of lithological analysis. Based on the results of the analysis of rock magnetic characteristics, it was established that in the Middle Pleistocene there were significant climatic fluctuations even during the cooling stage. The ferromagnetic, paramagnetic, and superparamagnetic components of magnetic susceptibility change synchronously along the section, increasing several times in magnitude in soil horizons.

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