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Quantitative distribution and ecological amplitude of land snail Metodontia on the Chinese Loess Plateau and adjacent regions

Fengjiang Li (1,2), Naiqin Wu (1,2,3), Yajie Dong (1), Houyuan Lu (1,3,4), Xiaoyun Chen (5), Dan Zhang (1,3), Yueting Zhang (1,3), Linpei Huang (6), and Bin Wu (7)

(1) Institute of Geology and Geophysics, Chinese Academy of Sciences, Key Laboratory of Cenozoic Geology and Environment, Beijing, China (fengjiangli@mail.iggcas.ac.cn), (2) Institutions of Earth science, Chinese Academy of Sciences, Beijing 100029, China, (3) College of Earth Sciences, University of Chinese Academy of Sciences, Beijing 100049, China, (4) Center for Excellence in Tibetan Plateau Earth System Science, Chinese Academy of Sciences, Beijing 100101, China, (5) Geological Museum of China, Beijing 100034, China, (6) Key Laboratory of Plateau Lake Ecology and Global Change, Yunnan Normal University, Kunming, Chenggong 650500, China, (7) State Key Laboratory of Environmental Criteria and Risk Assessment, Chinese Research Academy of Environmental Sciences, Beijing 100012, China

Land snails are one of the most abundant and representative fossil remains in loess deposits. They have been used as a unique biological proxy for reconstructing paleoclimate change. Metodontia genus is among the common land snails in the Chinese Loess Plateau and adjacent regions. Metodontia huaiensis and Metodontia yantaiensis are the two most common species in this genus. Up to now, classification and geographical distribution of Metodontia have made significant progress, providing crucial knowledge for using Metodontia taxon as warm and moist species to decipher paleoclimatic changes. However, little is known about quantitative distribution and ecological amplitude of Metodontia, which makes it almost impossible to understand deeply or quantitatively paleoclimatic changes recorded by Metodontia. Here, land snail assemblages are collected from surface soil samples at 356 sites covering the Loess Plateau and adjacent regions, ranging in latitude from 29.75ºN to 43.70ºN and in longitude from 98.23ºE to 120.34ºE. Modern climatic data of the sampling sites are obtained by spatial interpolation on the 40-year averaged meteorological data from a database of more than 700 meteorological stations that is maintained by the China Meteorological Administration. Results show that, in the studied region, Metodontia with abundance more than 20% occur mainly in the region of MAT higher than 11°C and MAP between 550 mm and 850 mm, the region to the south of 36ºN and to the east of 110ºE, and regions with altitude below 750 m above sea level. Metodontia with abundance less than 10% occur on conditions of MAT between 5°C and 15°C, MAP between 380 mm and 700 mm, mainly in the regions of latitudes from 33ºN to 40.5ºN, longitudes from 103.7ºE to 117.5ºE, and altitude below 2000 m above sea level. Almost no Metodontia is observed in the regions of MAT below 5°C, MAP below 380 mm, and altitude higher than 2000 m above sea level. The calculated optimum MAT (R2=0.70, RMSEP=1.99) is 10.2∼14.1°C for Metodontia huaiensis and 8.9∼14.0°C for Metodontia yantaiensis; the calculated optimum MAP (R2=0.81, RMSEP=90.9) is 530∼800 mm for Metodontia huaiensis and 470∼750 mm for Metodontia yantaiensis. These results are useful for studies of Metodontia-based paleoclimate and land snail diversity.