Interpretation of sedimentary subpopulations extracted from grain size distributions of loess deposits in the Sea of Azov, Russia

Jie Chen¹, Taibao Yang², Mingrui Qiang³
EGU General Assembly, Geoscience Online, May 2020

Abstract

Loess-palaeosol sequences (LPS) in Eastern Europe, especially those in the Azov region, are among the most sensitive terrestrial archives for identification of past arvalian dynamics and Quaternary palaeoclimatic reconstruction. Grain size analyses of loess sediments are used to interpret these transport mechanisms and palaeoclimatic changes based on grainometric parameters and statistical decomposition methods. Here, we present the results of unscreening grain size distributions from a loess-palaeosol section at the Sea of Azov, Russia, by jointly applying the standard deviation method and end-member modelling. The results indicate that the two methods can produce similar grain size distributions but that end-member modelling has advantages in terms of quantitative and objective characteristics. In addition, three main loess subpopulations or end-members (EMs) with mode sizes of 8 μm, 18 μm and 32 μm, which represent distinct aerodynamic environments, are identified from the grain size distribution in the Azov region. Therefore, EM1 with a mode size of 8 μm is the integrated result of combining atmospheric circulation with other environmental processes. EM2 with a mode size of 18 μm is inferred to represent continuous background dust under non-dust storm conditions. EM3 with a mode size of 32 μm is a fraction transported in short-term, low-altitude suspension clouds during dust storm outbreaks. Of the three EMs, EM1 and EM2 have multiple origins due to their complex formations, whereas EM3 is primarily derived from the alluvial plains of different rivers flowing into the Sea of Azov.

Stratigraphy and methods

Methods used in this study

➢ Magnetic susceptibility (MS)
➢ Grain size analysis (GS)
➢ End-member modelling analysis (EMM)
➢ Standard deviation analysis (STD)

Study area

The Sea of Azov (45° 47′ N, 35° 39′ E) is an internal sea with an area of 37,600 km². It is situated in the southern area of the East European Plain and bordered by the Crimean Peninsula to the west and the East European Plain to the north and east.

Main rivers flowing into the sea are the Don and Kuban, accounting for more than 90% of total inflow.

➢ The Chumbur-Kosa section (46° 57’48″ N, 38° 50’42″ E) is situated on the southern bank of the Taganrog Gulf, comprising a sedimentary thickness up to ~16 m.

➢ A total of 120 bulk samples were collected at intervals of 5 cm from the top of the section down to 6 m.

Results

➢ The MS variations exhibit distinct characteristics with higher MS values occurring in palaeosols and lower MS values in loess (Fig. 4).

➢ Contents of fine and coarse silts range from 36.07 to 66.26% and 19.80 to 45.37%, respectively. Clay and sand fractions are minor components (Fig. 4).

➢ There are three subpopulations EM1, EM2 and EM3 with modal sizes of ~8 μm, 18 μm and 32 μm in CK section (Fig. 6).

Conclusions

➢ Three grain size EMs are identified in the CK section, EM1, EM2 and EM3.

➢ EM1 (8 μm) is the integrated result of combining atmospheric circulation with other environmental processes.

➢ EM2 (18 μm) represents continuous background dust under non-dust storm conditions.

➢ EM3 (32 μm) is indeed of coarse silt fractions that are transported in short-term, low-altitude suspension clouds during dust storm outbreaks.

➢ EM1 and EM2 have multiple origins due to their complex formations, whereas EM3 originates mainly from the alluvial plains of different rivers around the Sea of Azov.

Authors and Citations

1 Post-doctoral researcher, School of Geography Sciences, South China Normal University, Guangzhou 510006, China, jiechen2018@scnu.edu.cn
2 Professor, Institute of Glaciology and Geocryology, College of Earth and Environmental Sciences, Lanzhou University, Lanzhou 730000, China, ytaibao@lzu.edu.cn
3 Professor, School of Geography Sciences, South China Normal University, Guangzhou 510006, China, mingrui@scnu.edu.cn

Citation: Jie Chen, Taibao Yang, Mingrui Qiang, et al., Interpretation of sedimentary subpopulations extracted from grain size distributions in loess deposits at the Sea of Azov, Russia. Aeolian Research, 2020, 45: 100597.