Clay mineralogical changes in loess-soils sequences along an ecological gradient in northern Iran: Implications for palaeoenvironment

Shahriari, A.[1], Khormali, F.[1], Karimi, A.[2], Mousavidastenaei, M.[3], Lehndorff, E.[4] and Kehl, M.[5]

[1]Dept. of Soil Sciences, Faculty of Water and Soil Engineering, Gorgan University of Agricultural Sciences and Natural Resources, Iran. Email: *ashk_se80@yahoo.com
[2]Dept. of Soil Science, Ferdowsi University of Mashhad, Faculty of Agriculture, Iran.
[3]Dept. of Soil Science, Isfahan University of Technology, Faculty of Agriculture, Iran.
[4]Institute of Crop Science and Resource Conservation (INRES) - Soil Sciences, Bonn University, Germany.
[5]Institute of Geography, University of Cologne, Germany.

Abstract

Loess–palaeosol sequences can be evaluated in a number of ways and provide many different kinds of palaeoenvironmental proxy data (Schaetzl & Anderson, 2005). The correlation of soil clay mineralogy with climate conditions has been reviewed in numerous studies and it was suggested that clay mineralogy in soils may follow a weathering pattern, from hot and humid to cool and dry, in the order kaolinite→smectite→vermiculite→chlorite and mixed-layer phyllosilicates→ilite and mica (Sheldon & Tabor, 2009). The northern footslopes of the Alborz Mountains and an extensive hill area in northern Iran are covered by loess deposits divided by different types of interstadial and interglacial palaeosols (e.g., Khormali & Kehl, 2011). We hypothesized that climate has affected on soil formation processes and clay mineralogy. Therefore, changes in clay mineralogical composition were investigated in four loess-palaeosol sequences (Agh Band, Now Deh, Mobarak Abad and Neka sections) located along an ecological gradient for reconstruction of palaeoenvironment. Results of soil texture analysis showed silt particles were dominant particle (more than 50 % percentages) in the loess-palaeosol sequences and modern soils which confirmed aeolian source of loess deposit. Clay content increased from driest part to moist part of studied area while silt content decrease in more strongly developed palaeosol and modern soils horizons which it may reflected weathering processes of clay and/or its translocation and the distance from loess source. The loess-soils sequences contain illite, chlorite, kaolinite and smectite. Smectite, illite-smectite and vermiculite minerals were dominant mineral in more strongly developed modern soils and palaeosol horizons indicating to high precipitation and good vegetation cover (e.g., forest). Clay mineralogy changes and degree of soil development increase from dry to moist conditions reflecting the climate controlled degree of soil formation.

Keywords: Loess-palaesol sequences, palaeoclimate, palaeovegetation

References

[1] Khormali F, Kehl M. 2011. Micromorphology and development of loess-derived surface and buried soils along a precipitation gradient in Northern Iran. Quaternary International. 234: 109-123.
[2] Schaetzl RJ, Anderson S. 2005. Soils: Genesis and Geomorphology. Cambridge University Press. 833 p.
[3] Sheldon ND, Tabor NJ. 2009. Quantitative paleoenvironmental and paleoclimatic reconstruction using paleosols. Earth Science Reviews. 95:1-52.