

## RESEARCH ARTICLE

# Quantitative characterization of microstructure and research on spatial variation characteristics of loess of different strata in Luochuan, Shaanxi, China

Yupeng Chang<sup>1\*</sup>, Shaoqing Yuan<sup>2</sup>**1** PowerChina Northwest Engineering Corporation Limited, Xi'an, China, **2** School of Geological Engineering and Geomatics, Chang'an University, Xi'an, China

\* 2018126092@cdu.edu.cn



## Abstract

The complete sequence of loess strata in Luochuan has become a typical section in loess strata, and is the main focus of research for many scholars studying loess. We were based on the theory of aeolian loess and established a set of quantitative index parameters for loess microstructure through our previous research, such as equivalent diameter, sphericity, morphology ratio, orientation angle Phi, orientation angle Theta, pore Eq-Radius, throat Eq-Radius and throat channelLength. Through the quantitative characterization of various index parameters of the Luochuan loess, we found that the probability density of each index parameter meets a specific distribution well, and in terms of spatial dimension, it shows that as the depth of the strata increases, the average particle size and the mode of pore Eq-Radius, throat Eq-Radius and throat channelLength generally increase, while the mode of particle morphology ratio generally decreases. In addition, loess particles in deeper strata are less prone to vertical sedimentation and tend to deposit gently or horizontally. Most particles in different strata are distributed in a northwest or southwest direction. During the formation period of strata, the main cause for spatial differences is the material carrying force. We conducted a statistical analysis on the correlation between the macroscopic physical properties of loess and its microstructure index parameters. Specifically, we found a positive correlation between loess density and the average particle size and the mode of particle equivalent diameter. Additionally, we found a negative correlation between loess liquid limit and plastic limit, and the mode of particle morphology ratio. Furthermore, there was a negative correlation between permeability coefficient and the mode of pore Eq-Radius, throat Eq-Radius, and throat channelLength.

## OPEN ACCESS

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**Data Availability Statement:** All relevant data are within the manuscript and its Supporting Information files.

## Introduction

From the 19th century to the early 20th century, scholars from various countries conducted in-depth research on the causes of loess and proposed many different theories. Lyell believed that the causes of loess were alluvial, floodplain, lake sedimentation, and marine sedimentation. Richthofen proposed the eolian loess theory, and later, other researchers suggested the

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