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OSL-based loess chronologies in West and Central Asia: how precise and reliable?

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Numerical dating methods such as optically stimulated luminescence (OSL) have been applied to establish more reliable chronological frameworks for loess/paleosol sequences to better constrain reconstructions of past climate and environment change and compare and correlate those high resolution records in West and Central Asia and elsewhere. Quartz OSL dating is restricted to relative young deposits ≤50 to 70 ka (depending on the dose rate of the sediment) owing to the lower saturation level of quartz, which is in the range of 100-200 Gray. Quartz is faster to bleach and more stable than feldspar. Disadvantages in quartz OSL dating are mainly poor luminescence sensitivity and early saturation as well as feldspar contamination. Feldspar minerals allow for dating older sediments up to several 100 ka. However, feldspar minerals suffer from certain signal loss over time, so-called anomalous fading, which requires correction models partly not well understood and under discussion. Promising new methods for dating Upper and Middle Pleistocene loess are pulsed IRSL dating or post-IR elevated temperature IRSL (pIRIR) dating. The latter method shows remarkably lower fading rate than using the conventional low-temperature IRSL signals. The precision of single OSL/IRSL age estimates is normally within 5 and 10%. Independent age control, such as radiocarbon dating for sediments younger than 30 ka or high-resolution paleomagnetic studies, is substantially helpful to identify the limits of OSL/IRSL including their uncertainties, the accuracy and reliability of the performed dating technique. Luminescence age estimates are of great importance to set up more reliable chronological frameworks.

How precise and how reliable these chronologies are, will be discussed in case studies from Northern Iran, Tajikistan and China. Previous studies suggested that during the last interglacial/glacial cycle, periods of increased dust accumulation and soil formation in Northern Iran [1, 2] are synchronous with those recorded in Tajikistan [3] and China [4] but show also distinct differences. The loess region along the southern Caspian Lowlands is among the southernmost ones of the Northern Hemisphere representing an important spatial link between Southeast Europe and Central Asia [3]. These loess records reflect numerous cycles of climate change and landscape evolution in the southern Caspian Lowlands during the Middle to Upper Pleistocene. Loess represents one of the most important geoarchives recording past climate and past environment change in the region. Loess is an excellent sediment to show how mandatory it is to set up a reliable chronological framework in order to shed light in climate teleconnection of terrestrial environments between Europe and Central Asia. Keeping inherent and methodological limitations for fine-scale global correlation in loess research in mind, an accurate and precise age model is critical to set up a more reliable chronological framework and correlate Middle and Upper Pleistocene loess, palaeosol or even distinct layers on a regional and global scale.

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