Luminescence sensitivity of quartz, a tracer for aeolian transport? An example from the Ili Basin of southeast Kazakhstan

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INTRODUCTION

Luminescence sensitivity of quartz grains is often linked to the source rock (origin) and/ or the sedimentary history experienced by the quartz grains [1, 2], and is increasingly being investigated as an indicator of sediment transport [3]. In an aeolian setting, this would imply the need to investigate the link between potential source and sink sediments within a sedimentary basin to validate the interpretation of luminescence (Optically stimulated luminescence: *OSL* and Thermoluminescence: *TL*) sensitivity as a potential tool for provenance of quartz. All previous studies in aeolian environments, have focused on variations in OSL and TL sensitivity with depth in loess-palaeosol sequences; whereby sensitivity increases in soils and decreases in loess forming horizons. These observed variations have been linked to change in sediment source as a result of climate fluctuations [4, 5]. However, until now this hypothesis remains unvalidated. Recent work [6] also suggests that the observed variability in sensitivity down-profile may be dominated by syn and post-depositional processes of loess formation. Therefore, to better utilise luminescence sensitivity as tracer for aeolian transport, there is a need to test the 'proverbial link' between sensitivity of potential source and sink sediments within a sedimentary Basin. In this context, the Ili basin of southeast (SE) Kazakhstan, with its extensive piedmont loess deposits provides a natural laboratory to test this hypothesis. Here we investigate the luminescence sensitivity of fine grain quartz from loess deposits of varying ages, as well as from surface sediments collected from various depositional settings across the Ili Basin of SE Kazakhstan.

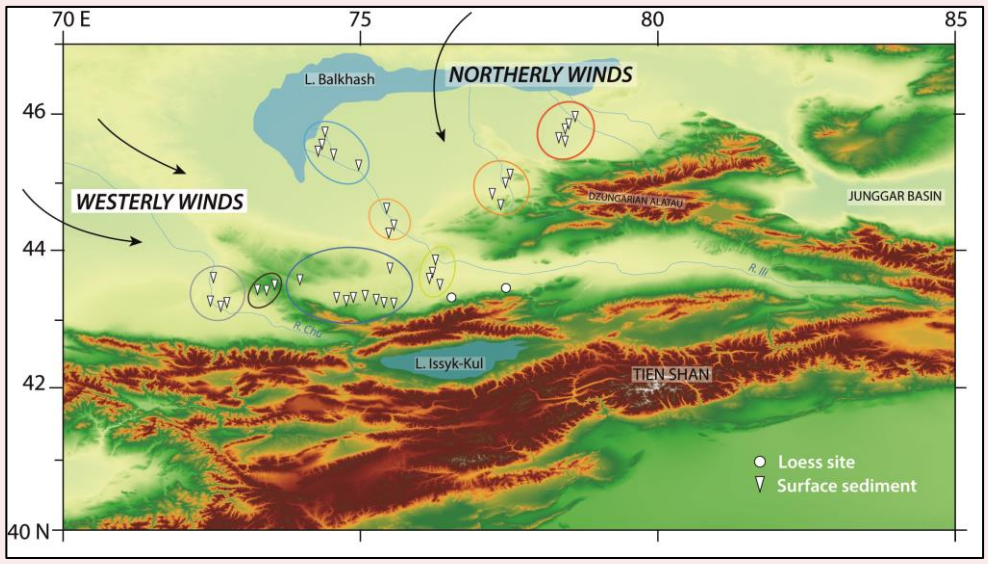
METHODOGY

- *4-11 μm quartz: 38* surface sediments (varying depositional settings) and 20 loess samples from two profiles (varying ages) in the Ili Basin of SE Kazakhstan.
- All OSL and TL measurements were performed using an automated Risø TL-DA-20 reader equipped with a $^{90}Sr/^{90}Y$ beta source at the Max Planck Institute for Chemistry, Mainz. The luminescence sensitivity of quartz was measured as per the protocol given in the Table.
- 8-12 aliquots of each sample were measured and normalised to the given laboratory dose and corresponding aliquot mass and expressed as counts/Gy.mg.

Table. Protocol for luminescence sensitivity measurements from fine grained quartz.

Steps	Measurement protocol
1	OSL 125°C, Blue LED 100 s at 5°C/s
2	β dose = 48 Gy
3	TL 240°C, 10 s at 5°C/s
4	IRSL 50°C, 50 s at 5°C/s
5	OSL 125°C, Blue LEDs for 100 s at 5°C/s

RESULTS



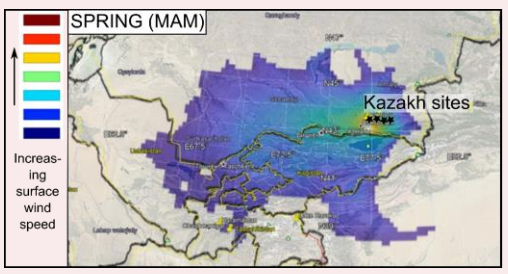
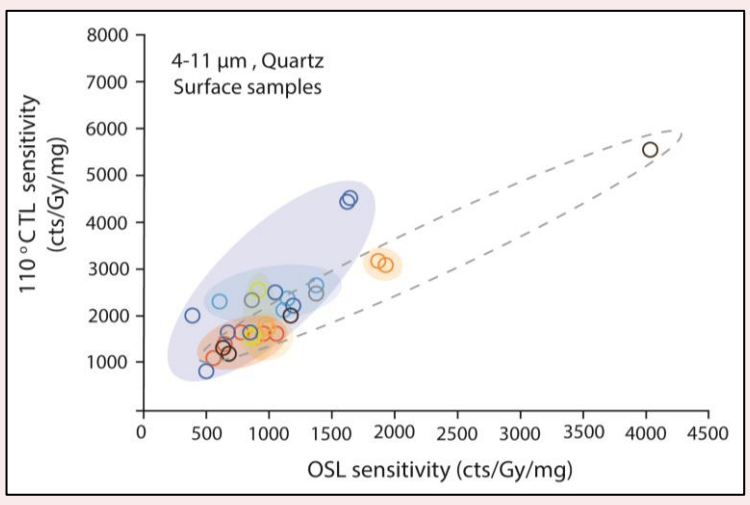
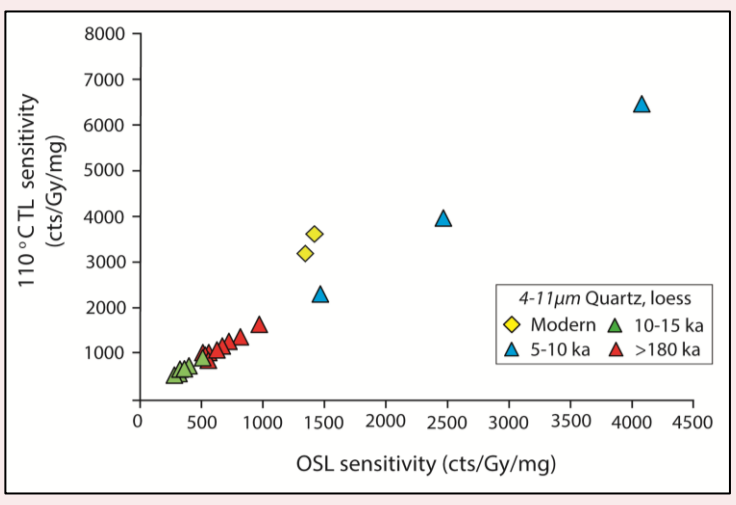


Figure *(above).* Climate re-analysis of wind trajectories and likely dust transport to Kazakh sites during the spring dust storm season [7]. Both westerly and northerly winds are currently responsible for transporting dust to the loess sites, implying multiple potential source areas which may have changed dominance through time.





CONCLUSIONS

- Fine grain quartz from surface sediments taken from potential source areas across the Ili Basin shows an overlap in luminescence sensitivity; however significant distinctions observed over smaller scales within the Basin.
- Difference in sensitivity observed in quartz from loess of varying depositional ages – an indicator of different dust transport pathways or a product of multiple factors (host rock, sedimentary history, syn and post-depositional processes)?
- Preliminary results suggest a need to test the hypothesis linking luminescence sensitivity variations in loess-palaeosol sequences to change in provenance as a result of climatic fluctuations.

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