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Grain-size Characteristics of Historical Proximal Aeolian Deposits at the Southwestern Margin of Poyang Lake (Postprint)

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Abstract

On the southwestern margin of Poyang Lake, downwind of aeolian sandy accumulation, thick layers of yellow-brown soil have developed. OSL dating indicates these are aeolian sand and dust accumulations from the Last Glacial Period. Along the Houtian-Daguling transect, analysis of sediment grain size from sand dunes to yellow-brown soil combined with geomorphology reveals: along the direction of the modern winter monsoon (NE 30°) from northeast to southwest, surface sedimentary facies gradually transition from sand to sandy loess to clayey loess, with grain size composition and parameters exhibiting systematic variations from north to south, indicating that both transport dynamics and provenance are singular and stable. The relationship between grain size parameters and distance from the source area follows a logarithmic function differentiation pattern, with the most dramatic changes occurring within approximately 20 km, after which the variation gradually stabilizes; 20 km represents the characteristic distance for clastic sorting. The research results provide evidence for the existence of an aeolian sand-dust accumulation system in the southwestern Poyang Lake region, and reveal the variation patterns of sedimentary indicators in proximal aeolian deposits, offering relevant theoretical references for provenance tracing of dust accumulations.

Full Text

Grain Size Characteristics of the Regional Sand-Dust Accumulation System Southwest of Poyang Lake

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Abstract

The yellow-brown soil in the southwestern margin of Poyang Lake, Jiangxi Province, was formed by aeolian sand and dust accumulation during the last glacial period, as revealed by optically stimulated luminescence (OSL) dating. Based on grain size analysis and geomorphological and sedimentological study of the sand hill and solum (yellow-brown soil) in the Houtian-Daguling transect on the southwest bank of the Gan River, we conclude that the sedimentary facies of this section transition systematically from sand to sandy loess soil to clay loess along the present winter monsoon direction (NE30°). Grain composition and parameters show a systematic change from north to south, reflecting transport momentum and a single stable provenance. The grain parameters display a logarithmic functional relationship with distance from the source. Within 20 km, they change significantly, but beyond this distance they gradually stabilize. Thus, 20 km may represent a characteristic sorting distance for debris. OSL dating indicates that the accumulation system formed at 94.18 ± 4.82 ka, consistent with the regional chronological framework. This study of the regional sand-dust accumulation system provides a theoretical basis for provenance identification of dust deposits.

Keywords: Houtian-Daguling transect; regional sand-dust accumulation system; yellow-brown soil; grain size; systematic change

Introduction

The southwestern margin of Poyang Lake hosts a well-preserved regional sand-dust accumulation system developed during the last glacial period. The Houtian-Daguling transect, located on the southwest bank of the Gan River, provides an ideal natural sequence for investigating sedimentary facies transitions and grain size evolution in aeolian deposits. Previous research has documented the Quaternary stratigraphy and paleoclimatic significance of aeolian sediments in this region, but systematic analysis of grain size characteristics along transport pathways remains limited.

Study Area and Methods

The study area lies within the Gan River valley, where the prevailing winter monsoon direction is NE30° with wind speeds of 2.4–3.2 m · s⁻¹. Three primary sampling sites were investigated along the transect: HT-04, ZS-01, and DG-02. Sample HT-04 was collected at 1.25 m depth with 21 sampling points. Sample ZS-01 covered a depth range of 0–1.4 m with 12 samples. Sample DG-02 extended to 3.4 m depth with 12 samples located 90 km from the sediment source.

Grain size analysis employed multiple instruments to cover different size fractions: a for the 0–3000 μm range, a for the 26–1100 μm range with 45.8%–90.5% measurement coverage, and a (cid : 154)67 2300μm (cid : 150), (cid : 211)Y; b5 3 ?S4 5m 0 0 4m\, BXZ) 0 4 1 5m24 9 “G (cid : 226). for the 1.5–120 μm range. The silt fraction (4–63 μm) ranged from 12.7%–56.1%, while the clay fraction (cid:154) i p, (cid:229)” XÆ(cid:226)(cid:223)K(cid:134)>@., (cid:226).\$) ranged from 0.60–0.08 μm, representing 4.5% of the distribution. OSL dating was conducted using standard protocols to establish the chronology of accumulation.

Results

The sedimentary sequence exhibits three distinct facies: sand, sandy loess soil, and clay loess, arranged systematically along the NE30° transport direction. Grain size parameters demonstrate clear north-to-south trends, with the coarse fraction (> 63 μm) decreasing from 72.8%–91.7% in proximal areas to 38.13%–49.00% in distal locations. The sorting coefficient ((cid:154) 0 . 1 7 ~ 0 . 5 0 m.

X, wxR(cid:209)(cid:204), (cid:210)9(cid:211)k(cid:217)}(cid:218)(cid:212)k. A?...%(cid:143) S;A? (RHT - 0 3) (cid:226)(cid:144)(cid:148)89Oa>:(cid:223) (cid:190)j 1 2 @.

K, ,,}Æ(cid:226):sc:, (cid:211)YB 4 2 . 5%~5 7 . 9%, C (9) <=>A? 3 (DG - 0 3), -b<=> - “S;L(cid:254)j@(cid:153)V, (cid:226).\$) ranges from 67–2010 μm, indicating moderate to poor sorting typical of aeolian deposits.

Within 20 km of the source, grain size parameters change logarithmically with distance, showing rapid fining trends. Beyond this distance, the rate of change diminishes and parameters stabilize, suggesting a characteristic sorting distance for the system. The median grain size decreases systematically while the clay content increases with distance from the source.

OSL dating results from sample LJ-01 yielded ages of 94.18±4.82 ka, 65.42±3.34 ka, 15.28±0.76 ka, and 10.90±0.57 ka for different horizons, establishing that the accumulation system initiated during the last glacial period and continued through the late Pleistocene.

Discussion

The systematic grain size variation reflects a single, stable provenance with consistent transport dynamics dominated by the winter monsoon. The 20 km characteristic distance represents the zone of active sorting where gravitational settling and saltation processes fractionate particles according to size. Beyond this zone, atmospheric suspension becomes the dominant transport mechanism, resulting in more uniform grain size distributions.

The transition from sand-dominated proximal facies to clay-enriched distal facies follows established models for aeolian deposition. The yellow-brown soil represents a weathered loessic deposit that has undergone post-depositional pedogenesis while retaining its primary aeolian texture. The consistency between OSL ages and regional stratigraphic frameworks confirms that this accumulation system correlates with global glacial-interglacial cycles.

Conclusion

This study demonstrates that the regional sand-dust accumulation system southwest of Poyang Lake exhibits systematic grain size changes along a 20 km transport pathway, with three distinct sedimentary facies reflecting distance from source and transport energy. The OSL chronology places formation of this system in the last glacial period. These findings provide a quantitative basis for provenance identification of dust accumulations and contribute to understanding Quaternary paleoenvironmental evolution in the Poyang Lake basin.

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Figure Captions

Fig. 4 Typical frequency curves of grain size of samples from HT-04

Fig. 5 Typical frequency curves of grain size for yellow-brown soil along Houtian-Daguling transect (m, %)

Fig. 8 Scatter diagrams of grain size of yellow-brown soil along Houtian-Daguling transect

Fig. 9 Some coefficients of grain size of yellow-brown soil along Houtian-Daguling transect, shown as a function of distance southwest of the point in the Gan River valley (see in Fig. 1)

Fig. 10 Some coefficients of silt particle peak of sample grain size of Houtian-Daguling transect, shown as a function of distance southwest of the point in the Gan River valley (see in Fig. 1)

Fig. 11 Some coefficients of fine clay particle peak of sample grain size of Houtian-Daguling transect, shown as a function of distance southwest of the point in the Gan River valley

Fig. 12 Environmental radioactivity and OSL dating results

Table OSL dating results for samples from the Houtian-Daguling transect

Sample ID	Depth (m)	Equivalent Dose (Gy)	Age (ka)
Lj-01-01	3.02±0.15	284.60±4.38	94.18±4.82
Lj-01-03	3.22±0.16	210.78±3.19	65.42±3.34
Lj-01-05	3.56±0.17	54.38±0.52	15.28±0.76
Lj-01-06	3.39±0.17	36.98±0.63	10.90±0.57

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