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The Geological Society of London Engineering Group Working Party on Periglacial and Glacial Engineering Geology

Poster Author: Dr David Giles, Principal Lecturer in Engineering Geology
School of Earth and Environmental Sciences, University of Portsmouth, UK
dave.giles@port.ac.uk

Abstract: The Engineering Group of the Geological Society of London established a Working Party to undertake a state-of-the-art review on the ground conditions associated with former Quaternary periglacial and glacial environments and their materials, from an engineering geological viewpoint. The book is not intended to define the geographic extent of former periglacial and glacial environments around the world, but to concentrate on ground models that would be applicable to support the engineering geological practitioner.

The Working Party considered the following topics with respect to engineering geology: Quaternary Setting, Geomorphological Framework, Glacial Conceptual Ground Models, Periglacial and Permafrost Conceptual Ground Models, Engineering Materials and Hazards, Engineering Investigation and Assessment, Glacial and Periglacial Soil and Rock Logging along with Design and Construction Considerations. The book also included a substantial set of case studies highlighting the investigation and design challenges presented by these terrains.

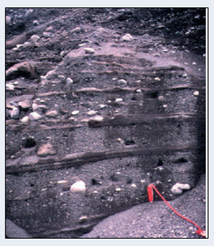
Proposed Nomenclature for the Engineering Description of Glaciogenic and Periglacial Soils

Proposed naming scheme for the *Geological Origin* and *Geological Qualifier for Origin* for the formal engineering description of glacial and periglacial soils. The book details the diagnostic characteristics of the key glaciogenic and periglacial materials that could be encountered in a UK ground investigation. To illustrate the descriptions high resolution photos have been included of type examples along with key references, both from the process of deposition and engineering behavioural aspects.

GEOLOGICAL ORIGIN	GLACIAL DEPOSITS
Sediment deposited by a glacier sole either sliding over &/or deforming its bed, the sediment having been released directly from the ice by pressure melting &/or liberated from the substrate and then disaggregated & completely or largely homogenised by shearing.	Subglacial Traction Till 
Rock or sediment that has been deformed by subglacial shearing/deformation but retains some of the structural characteristics of the parent material. Glaciotectonite is the most common but also the most variable glacial deposit.	Glaciotectonite 
Clast-supported, massive to crudely stratified or graded diamictons. Sedimentology of depocentres is complex due to multiple cycles of redeposition. Typical facies associations comprise interbedded diamictons & discontinuous bodies of laminated lacustrine sediments & glaciofluvial sands & gravels. Internal disturbance common & characterized by normal faulting, flow folding & soft sediment deformation.	Mass flow debris 

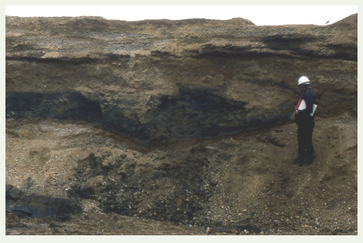
GEOLOGICAL ORIGIN	GLACIOLACUSTRINE & GLACIOMARINE DEPOSITS
Stratified sediments that display rhythmic or cyclic repetition of beds, related specifically to alternations between dominant grain size distributions. The term rhythmite is a non-genetic term used to refer to a range of deposits that display cyclic alternations in bedding, but is often replaced when the exact origins of the rhythms are known. Further subdivisions possible into cyclopels & cyclopsams.	Silt and clay rhythmites 
Individual turbidite can be identified as a graded vertical sequence of horizontally bedded/laminated sediments created by the passage & slowing of turbidity currents. Also display proximal-to-distal fining, reflecting the rapid deposition of coarse material & the transport of finer material into deeper parts of the basin.	Turbidites 
Concentrations of clasts occurring in discrete horizons in stratified sediment sequences.	Palimpsests 
Matrix-supported diamictons with strongly bimodal particle-size distributions, reflecting dominant suspension sedimentation & minor quantities of dropstones.	Ice rafted debris 
Created by sediment gravity flows from the flowage of concentrated sediment-water mixtures. Subaqueous slides & slumps occur whenever slopes fail along internal shear planes & undergo downslope transport. Debris flows, slides & slumps undergo transformations during transport depending on whether or not they lose or gain fluid, resulting in lateral & vertical changes in characteristics.	Mass flow debris 
Stratified diamictons containing numerous dropstones, winnowed lags & poorly sorted gravelly lenses.	Undermelt debris 

GEOLOGICAL ORIGIN	GLACIAL DEPOSITS
Displays 'pseudo-stratification', which includes discontinuous & contorted & sheet-like lamina, layers & lenses, textural & compositional banding, with strong clast macrofabrics.	Melt-Out Till 

GEOLOGICAL ORIGIN	GLACIOLFLUVIAL DEPOSITS
Transitional between debris flows & normal stream flows and particles are maintained in suspension by fluid turbulence. The flows can be homogeneous or be composed of an upper, low-concentration component & a lower, coarse-grained, high-concentration 'carpet'. Deposition of this material occurs when shear stresses & flow velocities fall in association with a reduction in stream gradient &/or flow depth.	Hyperconcentrated flow deposits 
Coarse-grained stratified sediments that display rhythmic or cyclic repetition of beds, related specifically to alternations between dominant grain size distributions.	Sand and gravel rhythmites 
Basic fluvial bedform types which are patterns in the bedload representative of a dynamic equilibrium response of the bed to prevailing flow conditions. They are repetitive, mobile structures that migrate down-current in response to the erosion of sediment from their upstream faces (high shear stress) & the deposition of sediment on their lee faces (low shear stress).	Ripple cross-laminations 
Basic fluvial bedform types which are patterns in the bedload representative of a dynamic equilibrium response of the bed to prevailing flow conditions. They are repetitive, mobile structures that migrate down-current.	Plane bed deposits 
Basic fluvial bedform types which are patterns in the bedload representative of a dynamic equilibrium response of the bed to prevailing flow conditions. They are repetitive, mobile structures that migrate down-current in response to the erosion of sediment from their upstream faces (high shear stress) & the deposition of sediment on their lee faces (low shear stress).	Cross-bedded dunes and antidunes 
Sheets accumulate through clast-by-clast accretion on low relief parts of river beds, normally in longitudinal & bank attached bars. Sediment transport and deposition are strongly episodic & take place during peak flows & subsequent waning flows.	Sand and gravel sheets 

GEOLOGICAL ORIGIN	PERIGLACIAL REGOLITH
Shallow mantle of in-situ bouldery regolith ranging from openwork to clast- or matrix-supported diamictons.	Blockfield 
Layer typically c. 1.5 m to a few metres thick beneath flat to gently sloping ground. Fractures predominantly horizontal to sub horizontal, increase in spacing as depth increases, and define rock blocks that are commonly tabular & parallel to the surface.	Brecciated bedrock 

GEOLOGICAL ORIGIN	PERIGLACIAL AEOLIAN DEPOSITS
Homogeneous & porous structure, absence of bedding (in primary 'airfall' loess) & a sigmoidal cumulative grain-size distribution curve with abundant coarse silt (20–50 μm) & a median particle size between 25 and 35 μm; faint stratification (few mm to few cm thick) locally present, may represent primary loess or loess reworked by e.g. sheetwash.	Loess 
Occurs as sheet of horizontally to sub horizontally stratified sand that forms a low-relief cover across a landscape. Further subdivisions possible into sand sheets or niveo-aeolian sands.	Coversand 
Large-scale cross-stratification.	Dune sand 

GEOLOGICAL ORIGIN	PERIGLACIAL FLUVIAL DEPOSITS
Stratified & sorted sheets or lenses of sand, pebbly sand or gravel, often observed in pre-Holocene river terraces. Further subdivisions possible into channel scours & finer grained sediments & organic beds.	Channel deposits 
Dark coloured to blackish organic-rich silt or sand forming sheet or infilling channel in sort gravel & sand. Further subdivisions possible into fluvio-aeolian deposits.	Floodplain deposits 

GEOLOGICAL ORIGIN	PERIGLACIAL SLOPE DEPOSITS
Clasts (pebbles to boulders) set within a sandy to silty matrix. Completely remoulded.	Granular head 
Reworked (partially remoulded) clayey debris.	Clay-rich head 
Better sorted & sometimes better stratified than granular head deposits (e.g. coombe rock) but less sorted & less stratified than river terrace deposits (i.e. intermediate between solifluction & fluvial deposits).	Fluvio-colluvial 
Thinly stratified & sorted deposits of silt, sand or pebbles.	Slopewash 
Clast- or matrix-supported diamicton, often openwork at surface, resting at angles > 33° at the foot of a cliff.	Talus 
Mantle of mobile or formerly mobile regolith derived from weathering of bedrock on upper slopes of mountains with gradients of ~5–35°. Depending on lithology, this may range from openwork to matrix-supported diamicts.	Blockslope deposits 
Poorly-sorted angular openwork debris with perched clasts & occasional soil drapes. Further subdivisions possible into rock or snow avalanche deposits.	Avalanche deposits 
Crudely-bedded clast or matrix-supported diamicton produced by rapid downslope flow of poorly-sorted debris mixed with water.	Debris flow deposits 

Reference

Griffiths, J.S. & Martin, C.J. (Eds.) (2016) *Engineering Geology and Geomorphology of Glaciated and Periglaciated Terrains*. Geological Society, London, Engineering Geology Special Publication.

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