Click to view animation--close-up of plane bed deposition Please wait to download (25 MB)

Graded and Massive Beds: A 3-D Mosaic of Coalesced, Rapidly-Deposited "Pod"-like Elements?*

Bill Arnott¹

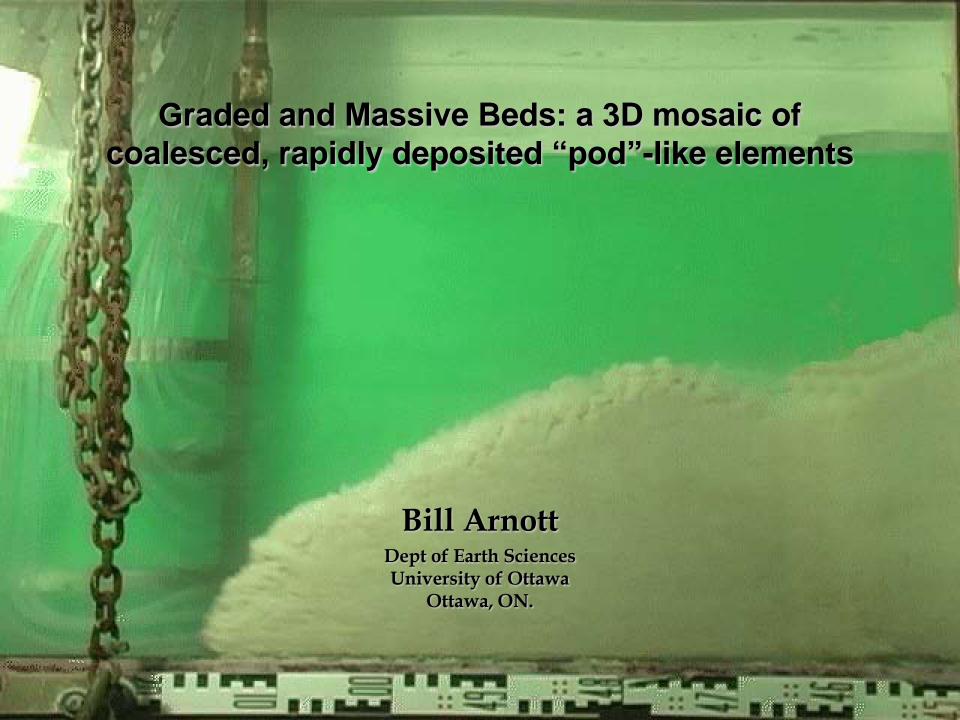
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Abstract

Although complete turbidites adorned with their traction-deposited sedimentary structures grab the limelight, it is the seemingly mundane graded and less common ungraded strata that make up the vast majority of the sand-rich deep-marine sedimentary record. Although classification schemes devised to classify these strata are numerous, central to most is the notion that deposition is directly from suspension. However, little discussion has been paid to the details of that deposition - is it slow or fast, incremental or as one big slug? A common observation in the sedimentary record is that graded and ungraded beds commonly show lateral variations, in places abruptly, of grain size and sorting made visible by local variations in cementation and/or weathering characteristics. Although it could be argued that these changes reflect local textural variations within the depositing turbidity current, a more consistent mechanism might be the lateral merging of discrete, independently- and rapidly-deposited "pods." Typically, pods merge imperceptibly (in three-dimensions) as their inherently loosely packed, water-saturated sediments fuse along their margins. In other cases, previously deposited and coalesced "pods" had sufficiently dewatered and consolidated but later were scoured, leaving a discernible erosion surface overlain by a new "pod." In this scenario deposition and related amalgamation occurs during a single event, and not, as might be assumed, the result of two separate turbidity currents. Suspension deposition was succeeded, at least commonly, and probably after a short hiatus, by bed-load transport and deposition that extended across the general bed surface and deposited planar- and/or cross-stratified sediment.



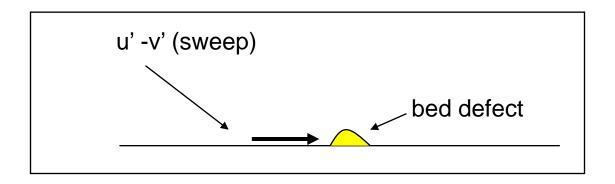








Disruption of flow separation

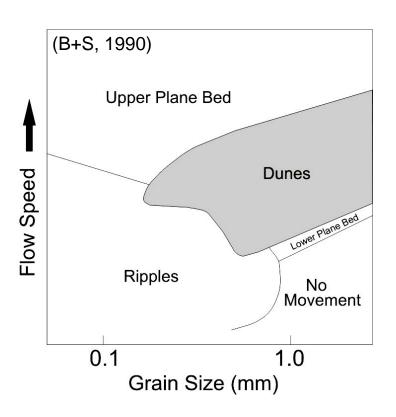




where defect causes flow separation → ripple

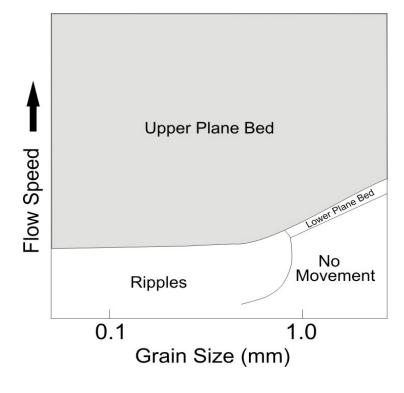
DYNAMIC

also **KINEMATIC** defects



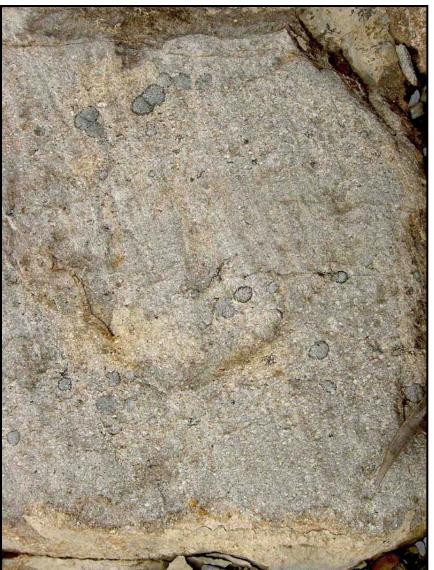
Low concentration (open channel)

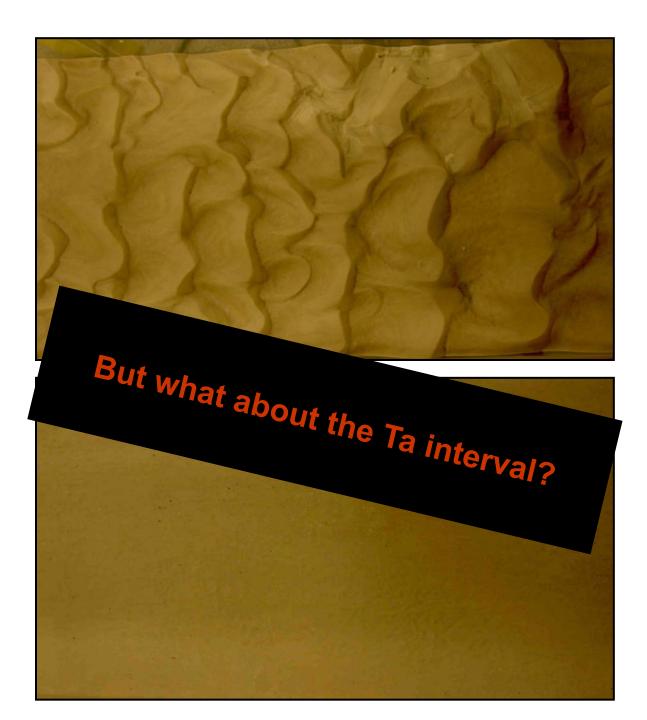






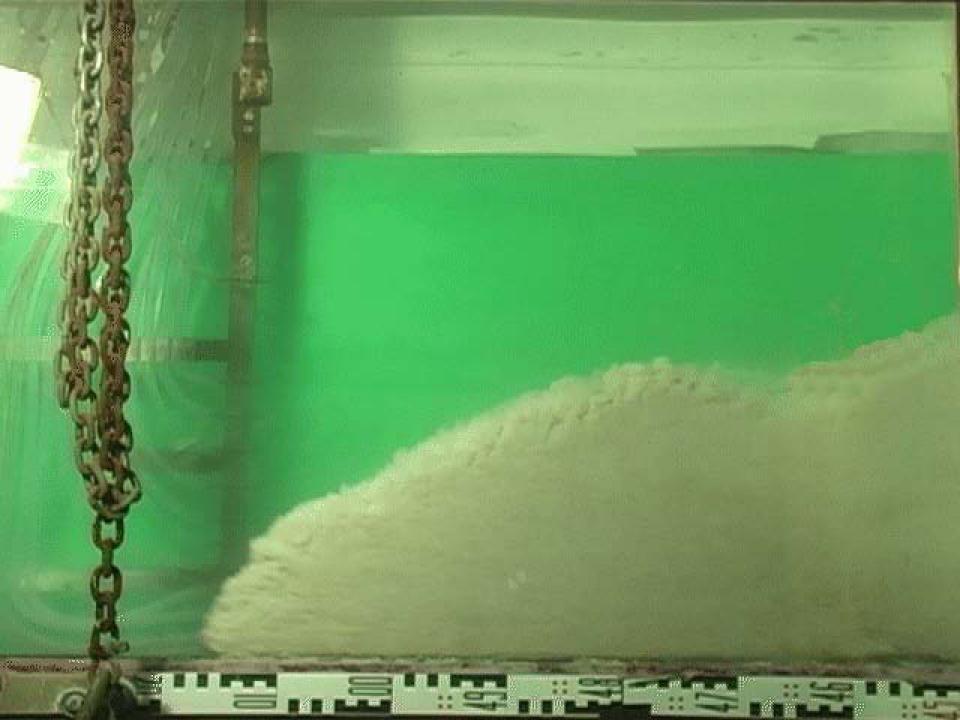


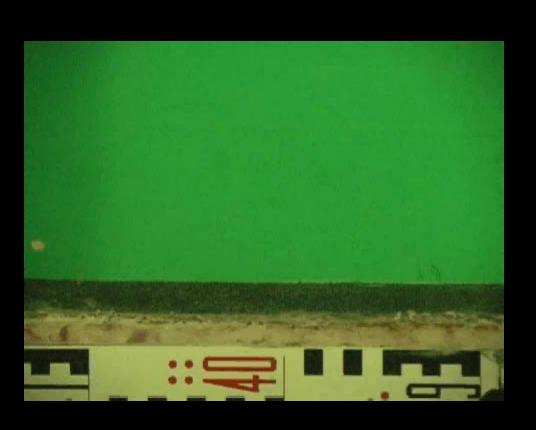




Tc

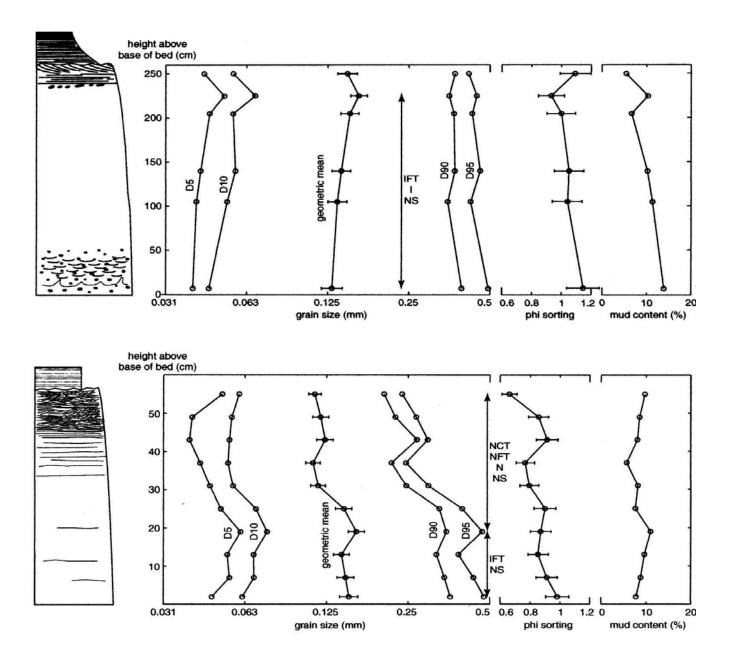
Tb



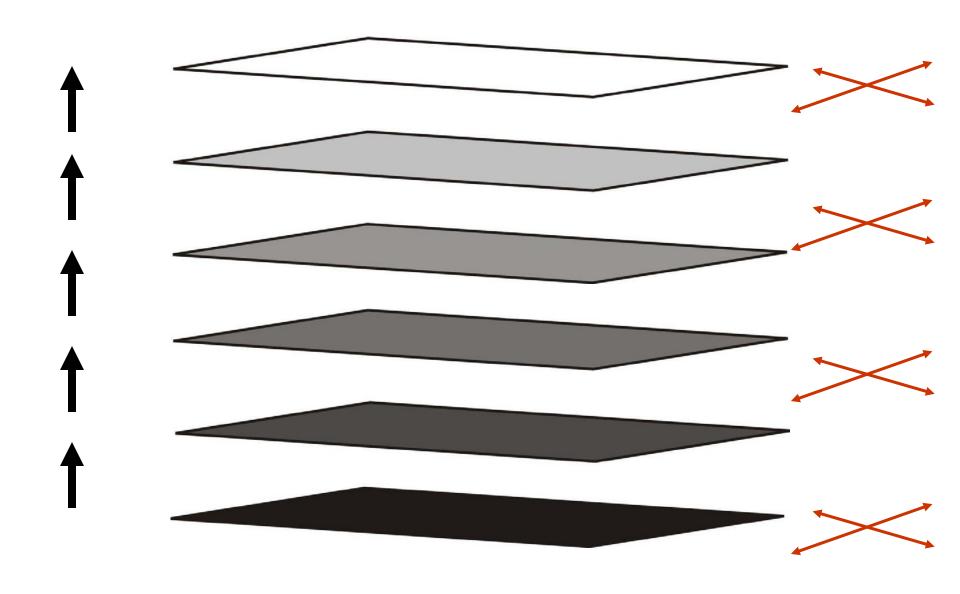


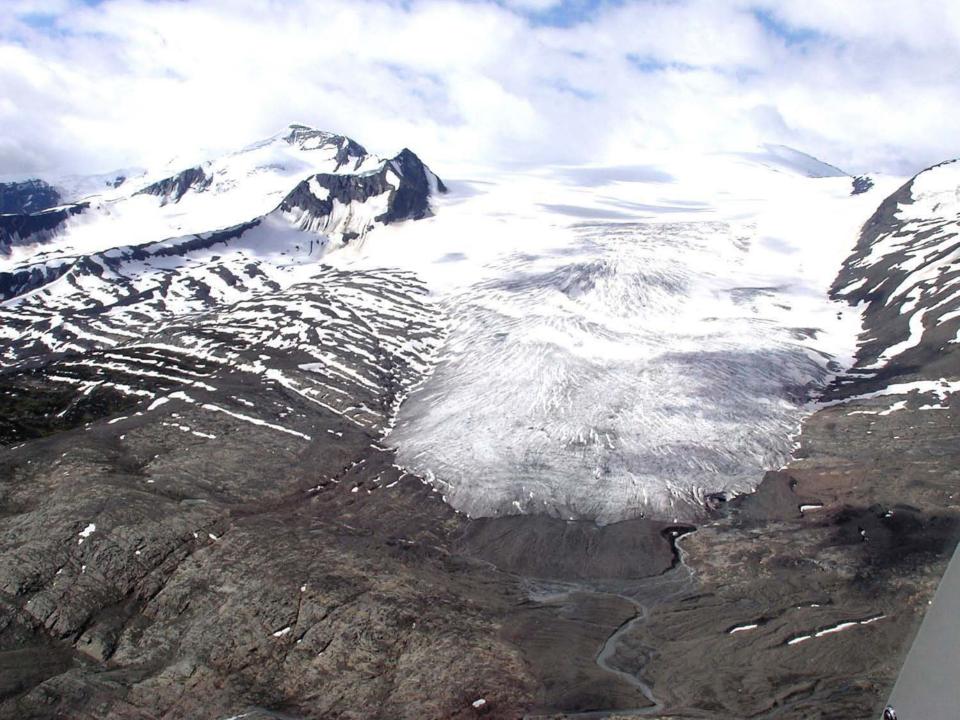


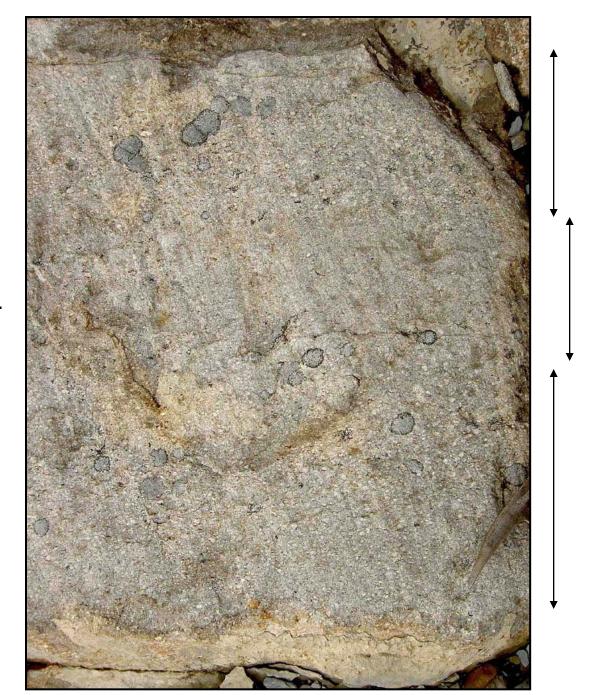




(Sylvester and Lowe, 2004)

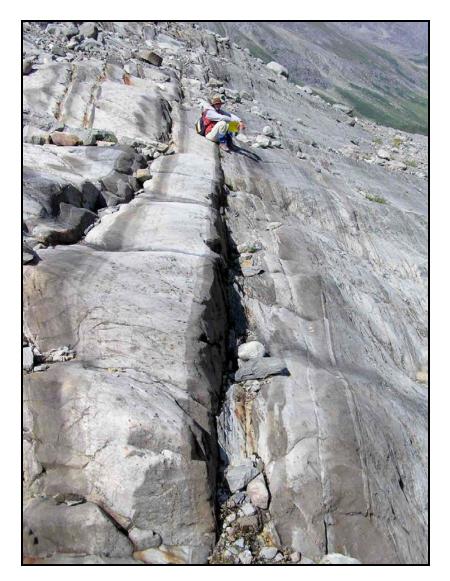






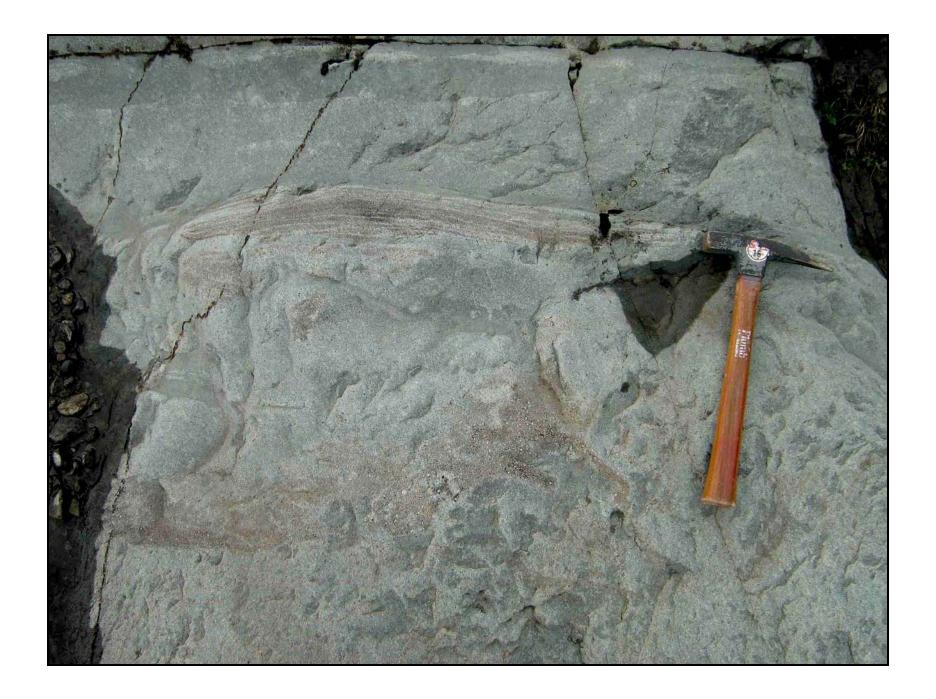
vertical and <u>lateral</u> changes in grain size, grain sorting

intrabed (red) carbonate cemented patches























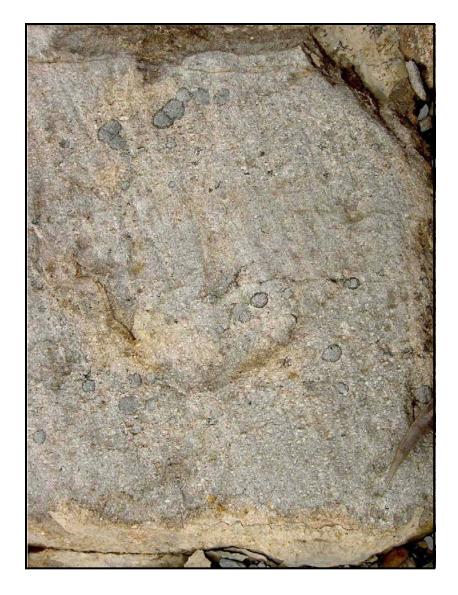
vertical, lateral textural changes

spatial variations: in flow or on <u>bed</u>



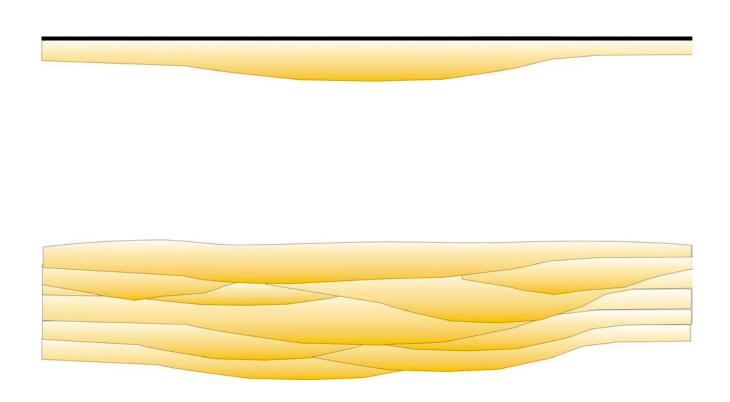


substrate poorly consolidated (rapidly deposited, water saturated internally sheared quick bed)

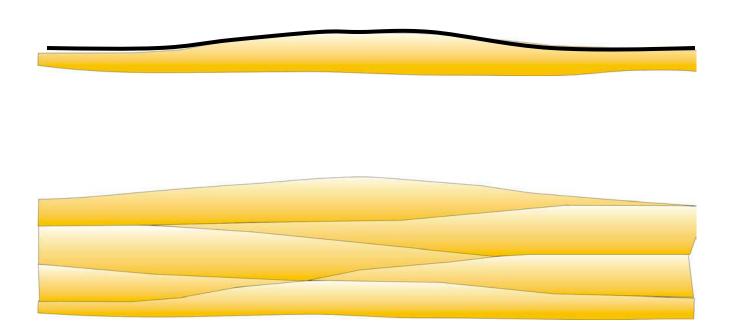


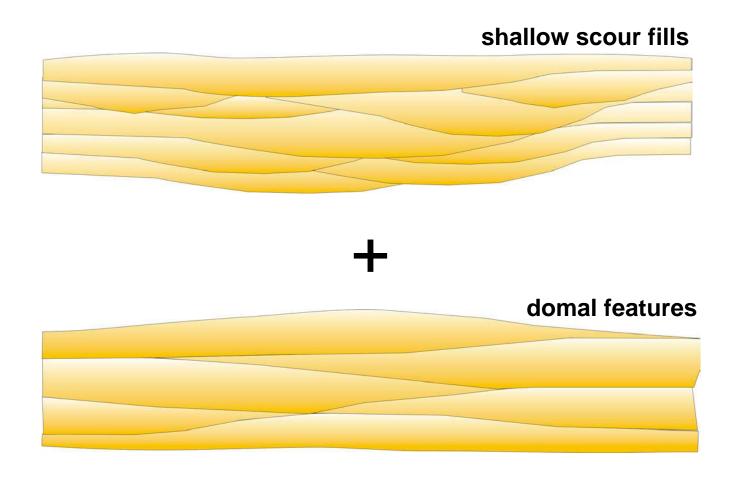
How does a Ta accumulate?

Shallow scour fills

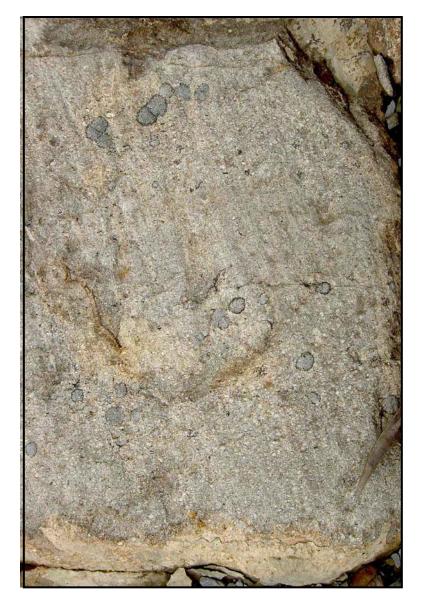


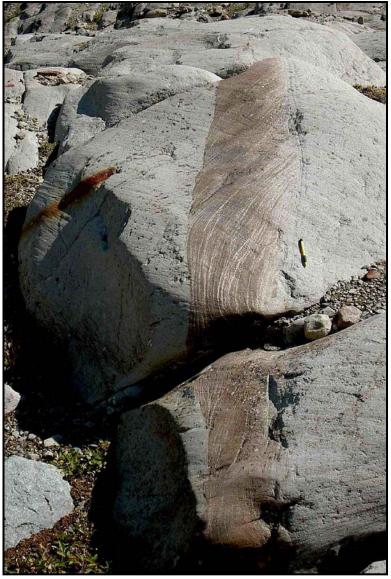
Domal build-ups





A 3D mélange of seemingly imperceptibly merged shallow scours +/- domes





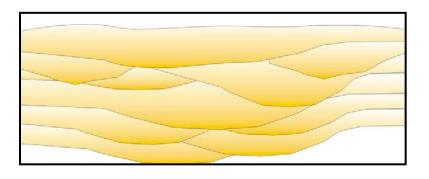
Hiatus in sedimentation -- from mostly suspension to 100% bed load f(sediment concentration, flow speed)

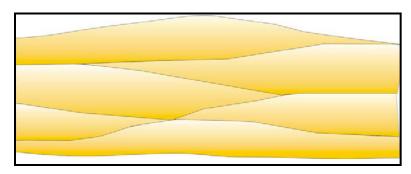
- sand-rich part of deep-marine sedimentary record
 - structureless, (coarse-tail) graded sandstone / conglomerate



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with ~unique stratal characteristics superimposed on a general upward trend





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- local reworking (traction)
 - intra-Ta (plane bed) but more common at top (plane bed and/or dunes)
 - commonly foundered
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- major mechanistic change across Ta to Tb transition
 - localized suspension to areally expansive traction deposition

