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TABLE 1 Ancient Deltaic Ichnology, Specifying the Dominant Process (Fluvial-, Tide-, Wave-Dominated, Mixed-Influence) or Type (Coarse-Grained and Shelf Margin), Lithostratigraphy, Core or Outcrop Data, Bioturbation Intensity and Lithology, Facies Interpretation, Trace Fossils and Ichnofacies

Delta type	Lithostratigraphic unit	Bioturbation	Interpretation	Trace fossils	Ichnofacies	References
Fluvial-dominated	Cretaceous Panther Tongue Sandstone, Book Cliffs, Utah, USA. Outcrop and GPR.	Rare to highly bioturbated (BI not defined). Siltstone to medium sandstone.	Fluvial-dominated delta. Delta front facies with hyperpycnal flow deposits including terminal distributary channel, mouth bar, distal mouth bar or proximal mouth bar facies during low discharge.	<i>Cylindrichnus</i> , <i>Ophiomorpha</i> , <i>Palaeophycus</i> , <i>Planolites</i> , <i>Thalassinoides</i> , <i>Teichichnus</i> , <i>Teredolites</i> and <i>Skolithos</i> .	<i>Skolithos</i> and proximal <i>Cruziana</i> .	Olariu et al. (2005, 2010), Olariu and Bhattacharya (2006).
	Cretaceous Ferron Sandstone, Southern Castle Valley, Utah, USA. Outcrop and core.	Absent to intense bioturbation (BI not defined). Shale to sandstone.	River-dominated delta. Interdistributary bays/marshes/splays, distributary channels, delta front facies, prodelta and flooding surfaces.	' <i>Anconichnus</i> ' (= <i>Phycosiphon</i>), <i>Arenicolites</i> , <i>Chondrites</i> , <i>Cylindrichnus</i> , <i>Helminthopsis</i> , <i>Lockeia</i> , <i>Monocraterion</i> , <i>Ophiomorpha</i> , <i>Palaeophycus</i> , <i>Planolites</i> , <i>Rosselia</i> , <i>Scolicia</i> , <i>Skolithos</i> , <i>Teichichnus</i> , <i>Thalassinoides</i> and <i>Zoophycos</i> .	Not defined.	Moiola et al. (2004).
	Cretaceous Ferron Sandstone, western Henry Mountains, Utah, USA. Outcrop.	Absent to high bioturbation (BI = 0-4). Siltstone to very coarse sandstone.	Flood-dominated/asymmetric delta. Distributary channel, marine influenced (tidal) distributary channel, coastal lagoon, mouth bar complex, proximal delta front, delta-lobe abandonment. Additional offshore, coastal mire and coastal floodplain facies not specified.	<i>Arenicolites</i> , <i>Chondrites</i> , <i>Cylindrichnus</i> , <i>Diplocraterion</i> , <i>Gyrochorte</i> , <i>Lockeia</i> , <i>Ophiomorpha</i> , <i>Planolites</i> , <i>Pterichnus</i> , <i>Rhizocorallium</i> , <i>Rosselia</i> , <i>Skolithos</i> , <i>Teichichnus</i> , <i>Teredolites</i> , <i>Undichna</i> and <i>Thalassinoides</i> .	Not defined.	Fielding (2010).
	Upper Cretaceous Dunvegan Formation, Allomember E, Alberta, Canada. Core.	Absent to intense bioturbation (BI not defined). Mudstone to sandstone.	River-dominated delta. Proximal delta front/distributary mouth bar, delta front and prodelta facies.	' <i>Anconichnus</i> ' (= <i>Phycosiphon</i>), <i>Arenicolites</i> , <i>Cylindrichnus</i> , <i>Helminthopsis</i> , <i>Ophiomorpha</i> , <i>Palaeophycus</i> , <i>Planolites</i> , <i>Rhizocorallium</i> , <i>Skolithos</i> , <i>Teichichnus</i> and <i>Zoophycos</i> .	Stressed proximal <i>Cruziana</i> and stressed <i>Cruziana</i> .	Gingras et al. (1998).
	Upper Cretaceous Alderson Member, Lea Park Formation, Canada. Core.	Absent to complete bioturbation (BI = 0-6). Organic-rich shale to medium-grained sandstone.	Mud-dominated deltaic coastline succession. Delta front, proximal prodelta-distal delta front, distal hyperpycnal prodelta and distal prodelta facies. Additional muddy shoreface facies not specified.	<i>Arenicolites</i> , <i>Chondrites</i> , <i>Helminthopsis</i> , <i>Phycosiphon</i> , <i>Planolites</i> , <i>Teichichnus</i> , <i>Thalassinoides</i> , <i>Schaubcylindrichnus</i> and <i>Zoophycos</i> .	<i>Glossifungites</i> .	Hovikoski et al. (2008).

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Tide-dominated	Late Cretaceous Frontier Formation, central Wyoming, USA. Outcrop.	Very sparse bioturbation (BI not defined). Mudstone to coarse-grained sandstone.	Tide-influenced delta. Tidal ridges on delta front facies.	<i>Arenicolites, Bergaueria, Macaronichnus, Ophiomorpha, Phycodes, Planolites</i> and <i>Teichichnus</i> .	Not defined.	Willis et al. (1999).
	Middle Jurassic Lajas Formation, Neuquén Basin, Argentina. Outcrop.	Absent to complete bioturbation (BI = 0-6). Mudstone to coarse-grained sandstone.	Tide-dominated delta. Tidal channels, abandoned tidal channels, tidal flats, bay fills, distributary channels, delta front and mouth bars, prodelta facies. Additional offshore shelf and floodplain facies not specified.	<i>Arenicolites, Asterosoma, Bergaueria, Chondrites, Diplocraterion, Gyrochorte, Gyrolithes, Lockeia, Monocraterion, Ophiomorpha, Planolites, Palaeophycus, Phoebichnus, Phycosiphon, Rhizocorallium, Rosselia, Siphonichnus, Skolithos, Taenidium, Teichichnus, Thalassinoides</i> and <i>Trichichnus</i> .	<i>Glossifungites</i> .	McIlroy et al. (2005).
	Jurassic Ile Formation, Kristin Field, Haltenbanken, offshore mid-Norway. Core.	Absent to high bioturbation (BI = 0-4). Mudstone to coarse-grained sandstone.	Tide-dominated delta. Tidal flats, tidal channels, proximal distributary mouth bars, central distributary mouth bar, distal distributary mouth bar, proximal prodelta. Additional tidal flat and tidal channel facies not specified.	<i>Asterosoma, Macaronichnus, Nereites, Phycosiphon, Planolites, Protovirgularia, Rosselia, Schaubcylindrichnus, Skolithos, Siphonichnus, Teichichnus</i> and <i>Thalassinoides</i> .	Mixed <i>Skolithos</i> and <i>Cruziana</i> .	McIlroy (2004a, b).
	Lower Miocene Chenque Formation, Patagonia, Argentina. Outcrop.	Absent to intense bioturbation (BI = 0-5). Mudstone to medium-grained sandstone.	Tide-influenced delta. Distal prodelta, proximal prodelta, transition zone, distal and proximal delta front facies.	<i>Asterosoma, Macaronichnus, Nereites, Phycosiphon, Planolites, Protovirgularia, Rosselia, Schaubcylindrichnus, Skolithos, Siphonichnus, Teichichnus</i> and <i>Thalassinoides</i> .	<i>Cruziana</i> , impoverished <i>Skolithos</i> and <i>Cruziana</i> .	Carmona et al. (2009).
	Cretaceous Sego Sandstone of the Mancos Shale, Book Cliffs, Utah, USA. Outcrop.	Near-absence to extensively bioturbated (BI not defined). Very fine- to coarse-grained sandstone.	Tide-dominated river delta. Tidal bar and tidal channel facies.	<i>Asterosoma, Ophiomorpha, Planolites</i> and <i>Thalassinoides</i> .	Not defined.	Willis and Gabel (2001), Willis (2005).
	Middle Cambrian Oville Sandstones and Shales, Spain. Outcrop.	Absent to high degree of bioturbation (BI not defined).	Tide-influenced delta. Delta slope, prodelta and bar facies.	<i>Arenicolites, Cruziana, Dimorphichnus, Diplichnites, Diplocraterion, Monomorphichnus, Phycodes, Planolites, Rusophycus, Skolithos</i> and <i>Teichichnus</i> .	Not defined.	Legg (1985).

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	Jurassic Tilje Formation, offshore Norway. Core.	Absent to high bioturbation (BI = 0-4). Mudstone to gravelly sandstone.	Tide-dominated delta. Tidal-fluvial channel, mouth bar and terminal distributary channel, delta front deposits.	<i>Asterosoma, Diplocraterion, Palaeophycus, Planolites, Rhizocorallium, Skolithos, Teichichnus</i> and <i>Thalassinoides</i> .	Not defined.	Ichaso and Dalrymple (2009).
	Upper Miocene, Nauta Formation, Marañón Foreland Subbasin, Peru. Outcrop.	Low to high bioturbation intensity. Ichnofabric index ii = 1-4 (cf. Droser and Bottjer, 1989). Mudstone and marls to medium-grained sandstone.	Tidal-channel deposits on a delta plain. Subaqueous dune, tidal point bars and subtidal to intertidal flat facies associations.	<i>Arenicolites, Chondrites, Cylindrichnus, Gyrolithes, Laminites, Ophiomorpha, Palaeophycus, Planolites, Psilonichnus, Rhizocorallium, Scolicia, Siphonichnus, Skolithos, Taenidium, Teichichnus</i> and <i>Thalassinoides</i> .	<i>Skolithos, Cruziana</i> , mixed <i>Skolithos-Cruziana, Glossifungites</i> .	Rebata-H et al. (2006).
Wave-dominated	Cretaceous Blackhawk Formation, Book Cliffs, Utah, USA. Outcrop.	Moderate bioturbation (BI = 3) in delta front facies. Mudstone to medium-grained sandstone.	Wave-dominated delta. Delta front facies, foreshore to delta front.	<i>Arenicolites, Conichnus, Cylindrichnus, Diplocraterion, Ophiomorpha, Palaeophycus, Planolites, Rhizocorallium, Rosselia, Skolithos, Teichichnus</i> and <i>Thalassinoides</i> .	Mixture of <i>Skolithos</i> and <i>Cruziana</i> .	Hampson and Howell (2005).
	Upper Cretaceous, Doe Creek Member, Kaskapau Formation, NW Alberta, Canada. Core.	Absent to moderate bioturbation (BI not defined). Mudstone to medium-grained sandstone.	Wave-dominated delta. Interdistributary/delta margin, distributary channels, distributary mouth bar, proximal delta front, distal delta front, proximal and distal prodelta facies. Additional shoreface facies not specified.	<i>Arenicolites, Asterosoma, Chondrites, Cylindrichnus, Diplocraterion, Helminthopsis, Lockeia, Macaronichnus, Ophiomorpha, Palaeophycus, Planolites, Phycosiphon, Rhizocorallium, Rosselia, Scolicia, Skolithos, Teichichnus, Thalassinoides</i> and <i>Zoophycos</i> .	Proximal and stressed <i>Cruziana</i> , extremely stressed and impoverished mixed <i>Skolithos-Cruziana, Skolithos</i> , impoverished <i>Skolithos</i> and <i>Glossifungites</i> .	Reid and Pemberton (2007).

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	Upper Cretaceous Blackhawk Formation, Aberdeen Member, Book Cliffs, Utah, USA. Outcrop.	Absent to intense bioturbation (BI not defined). Mudstone to coarse-grained sandstone.	Wave-dominated delta. Delta front facies (proximal and distal), slumps, channel fill and coastal plain.	Roots, other ichnotaxa not specified, only in terms of bioturbation intensity.	<i>Skolithos</i> and <i>Cruziana</i> .	Charvin et al. (2010).
	Miocene Tácata Field, Eastern Venezuela Basin, Venezuela. Core.	Absent to intense bioturbation (BI = 0-5).	Wave-dominated tropical delta. Interdistributary bay, tide-influenced distributary channels, terminal distributary channels, storm-dominated delta front and prodelta (proximal and distal) facies. Additional offshore facies not specified.	<i>Arenicolites</i> , <i>Asterosoma</i> , <i>Chondrites</i> , <i>Cylindrichnus</i> , <i>Diplocraterion</i> , <i>Helminthopsis</i> , <i>Monocraterion</i> , <i>Ophiomorpha</i> , <i>Palaeophycus</i> , <i>Phycosiphon</i> , <i>Planolites</i> , <i>Rosselia</i> , <i>Skolithos</i> , <i>Teichichnus</i> , <i>Thalassinoides</i> , <i>Trichichnus</i> and root traces.	<i>Skolithos</i> , <i>Cruziana</i> and <i>Glossifungites</i> .	Buatois et al. (2008).
	Upper Cretaceous Dunvegan Formation, Allomember D, Alberta, Canada. Core.	Low to abundant bioturbation (BI not defined). Mudstone to sandstone.	Wave-dominated delta. Proximal delta front/distributary mouth bar, delta front and prodelta facies. Additional non-marine delta plain and offshore facies not specified.	<i>Arenicolites</i> , <i>Asterosoma</i> , <i>Chondrites</i> , <i>Cylindrichnus</i> , <i>Diplocraterion</i> , <i>Helminthopsis</i> , <i>Macaronichnus</i> , <i>Ophiomorpha</i> , <i>Palaeophycus</i> , <i>Phycosiphon</i> , <i>Planolites</i> , <i>Rhizocorallium</i> , <i>Rosselia</i> , <i>Siphonichnus</i> , <i>Skolithos</i> , <i>Teichichnus</i> , <i>Thalassinoides</i> and <i>Zoophycos</i> .	<i>Skolithos</i> , proximal <i>Cruziana</i> and distal <i>Cruziana</i> .	Gingras et al. (1998).
Mixed-influence	Holocene, Burkedin River Delta, Northeastern Australia. Outcrop.	Absent to extensively bioturbated in lower delta-plain facies, extensively bioturbated in delta-front facies (BI not defined).	Mixed river- and wave-influenced delta. Lower delta plain (distributary channel, tidal creek, mangrove swamp, salt flat, coastal flat, foreshore/beach ridge/spit and aeolian dune) and delta-front facies (mouth bar, shoal, lower delta front and embayment).	Ichnotaxa not specified. Variety of modern invertebrates (crabs and mollusks) and mangrove rootlets.	Not defined.	Fielding (2005), Fielding et al. (2006).
	Permian Denison Trough succession, Queensland, Australia. Core and outcrop.	Absent to intense bioturbation (BI not defined for all facies). Claystone to coarse-grained sandstone.	Mixed river- and wave-influenced delta lobes. Distributary channel, lower delta plain distributary channel, river mouth, mouth bar, delta front (proximal and distal) and prodelta. Additional non-deltaic shoreface to offshore facies and upper delta plain not specified.	<i>Asterosoma</i> , <i>Chondrites</i> , <i>Cylindrichnus</i> , <i>Diplocraterion</i> , <i>Gyrolithes</i> , <i>Helminthopsis</i> , <i>Macaronichnus</i> , <i>Palaeophycus</i> , <i>Phycosiphon</i> , <i>Planolites</i> , <i>Psammichnites</i> , <i>Rhizocorallium</i> , <i>Rosselia</i> , <i>Teichichnus</i> and <i>Zoophycos</i> .	<i>Skolithos</i> , proximal and stressed <i>Cruziana</i> , stressed distal <i>Cruziana</i> .	Bann and Fielding (2004).

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	Upper Cretaceous, Allomember G, Basal Belly River Formation, Alberta, Canada. Core.	Absent to moderate bioturbation intensity (BI = 0-3). Siltstone to medium-grained sandstone.	Mixed wave- and river-influenced delta. Asymmetric delta. Wave- and storm-influenced delta facies; delta front, proximal prodelta to distal delta front and prodelta. River-dominated delta facies; lagoon/bay, delta front to delta plain, distal delta front to prodelta.	<i>Asterosoma, Chondrites, Cosmorhapha, Cylindrichnus, Diplocraterion, Helminthopsis, Macaronichnus, Ophiomorpha, Palaeophycus, Phycosiphon, Planolites, Rhizocorallium, Rosselia, Skolithos, Teichichnus</i> and <i>Thalassinoides</i> .	Mixed <i>Skolithos</i> and <i>Cruziana</i> , stressed mixed <i>Skolithos/Cruziana</i> and stressed <i>Cruziana</i> .	Hansen and MacEachern (2007).
	Cretaceous upper Turonian Wall Creek Member, Powder River Basin, Wyoming, USA. Outcrop.	Absent to intense bioturbation (BI = 0-5). Mudstone to medium-grained sandstone.	Mixed-influence delta. Proximal delta front, storm sheet, channel, distal delta front and prodelta.	<i>Arenicolites, Asterosoma, Bergaueria, Chondrites, Cylindrichnus, Diplocraterion, Gyrochorte, Helminthopsis, Lockeia, Macaronichnus, Monocraterion, Ophiomorpha, Palaeophycus, Planolites, Rosselia, Skolithos, Teredolites</i> and <i>Thalassinoides</i> .	<i>Skolithos</i> , mixed <i>Cruziana</i> and <i>Skolithos</i> , distal <i>Skolithos</i> and distal to archetypal <i>Cruziana</i> .	Gani and Bhattacharya (2007).
	Late Cretaceous Mississauga Formation, Glenelg Field, Offshore Nova Scotia, Canada. Core.	Absent to intense bioturbation (BI not defined). Mudstone to medium-grained sandstone.	Shelf-margin delta (storm- and tide-influenced). Delta front, storm-dominated upper and lower delta front, storm-dominated transition, tide-dominated delta front, tide and storm-influenced prodelta deposits.	<i>Asterosoma, Chondrites, Cylindrichnus, Helminthopsis, Ophiomorpha, Palaeophycus, Planolites, Rosselia, Skolithos, Teichichnus</i> and <i>Zoophycos</i> .	Not defined.	Cummings and Arnott (2005), Cummings et al. (2006).
Coarse-grained	Quaternary, Conway Flats, New Zealand. Outcrop.	Absent to intense bioturbation (BI not defined). Mudstone to conglomerate.	Gilbert-type fan delta. Distributary channel, proximal and distal embayment, bar and prodelta.	<i>Aborichnus, 'Anconichnus' (=Phycosiphon), Arenicolites, Asterosoma, Cylindrichnus, Diplocraterion, Gordia, Helminthoida, Ophiomorpha, Piscichnus, Planolites</i> and <i>Skolithos</i> .	Not defined.	Ekdale and Lewis (1991), McConnico and Basset (2007).
	Pliocene deposits of Ventimiglia, Western Ligurian Coast, NW Italy.	Absent to pervasive bioturbation (BI not defined). Siltstone to conglomerate.	Gilbert-type delta complex. Upper prodelta slope, topset facies/fluvial braided distributary channels, bars, foreset facies/middle and lower foreset, gravel beach, gravity flow, toset facies/debris flow or avalanche, chute channel mouth, bottomset facies/turbidites. Additional non-deltaic facies are gravity flow, shoreface and distal turbidite facies.	<i>Conichnus, Diplocraterion, Ophiomorpha, Skolithos, Teichichnus</i> and <i>Thalassinoides</i> .	Not defined.	Breda et al. (2007).

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The reference list is based on publications with a minimum, specific text on ichnotaxa and bioturbation intensity (abstracts and unpublished data are not included). Tidal deltas are ichnologically well studied, whereas fluvial- and wave-dominated and mixed-influence deltas are comparatively understudied (again with focus on the delta front and often neglecting other subenvironments). Gilbert-type, coarse-grained and shelf-margin deltaic ichnology are grossly understudied. Ichnofacies delineation is varied, although a wider range of ichnofacies exists in wave-dominated and mixed-influence ancient deltas.

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