Sand tells a story

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CURIOSITY

Topics of talk

Why study sand?

Examples

How sedimentology helped change Glen Canyon Dam operations

Objective of talk

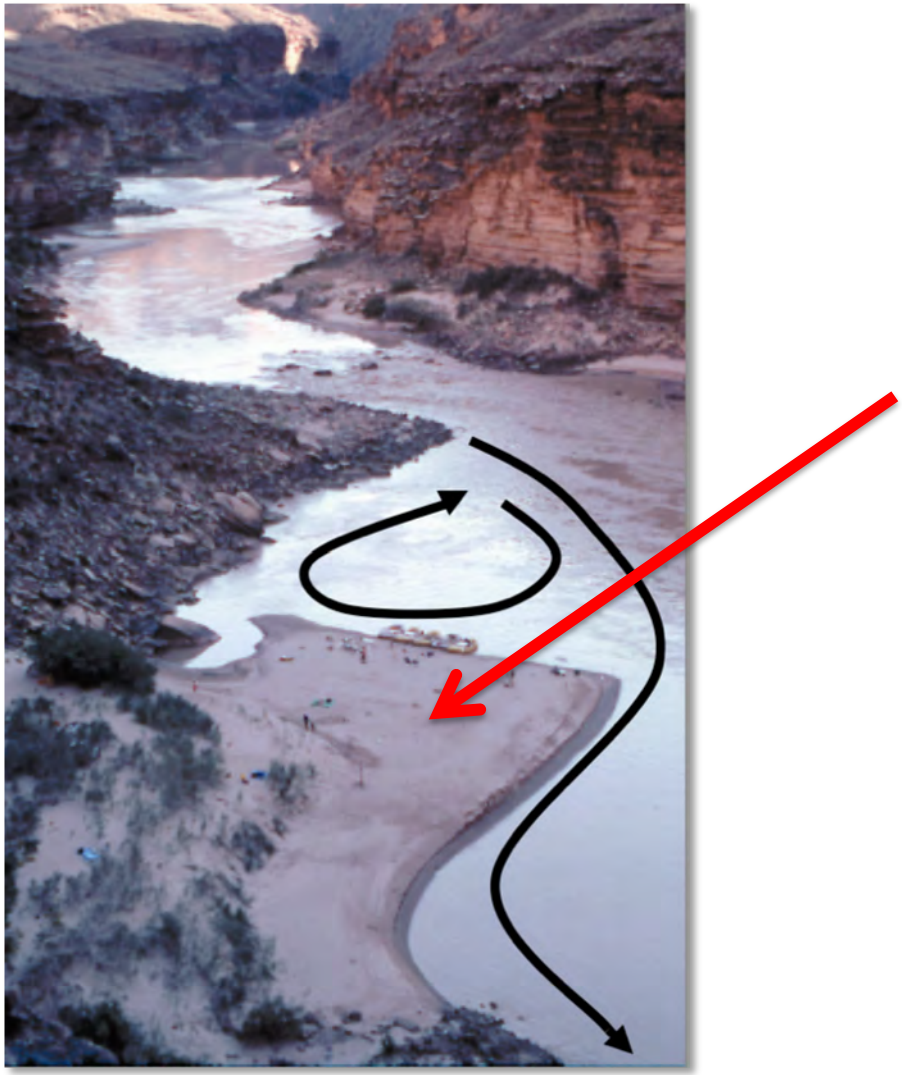
When you look at sand, sandstones, or planets in the night sky, remember that the sand is telling a story.

Why study sand?

It is a natural record of the fluid processes that build sand bars and other landforms.

Sand deposits can be interpreted after-the-fact, with no advance planning and no scientific instruments.

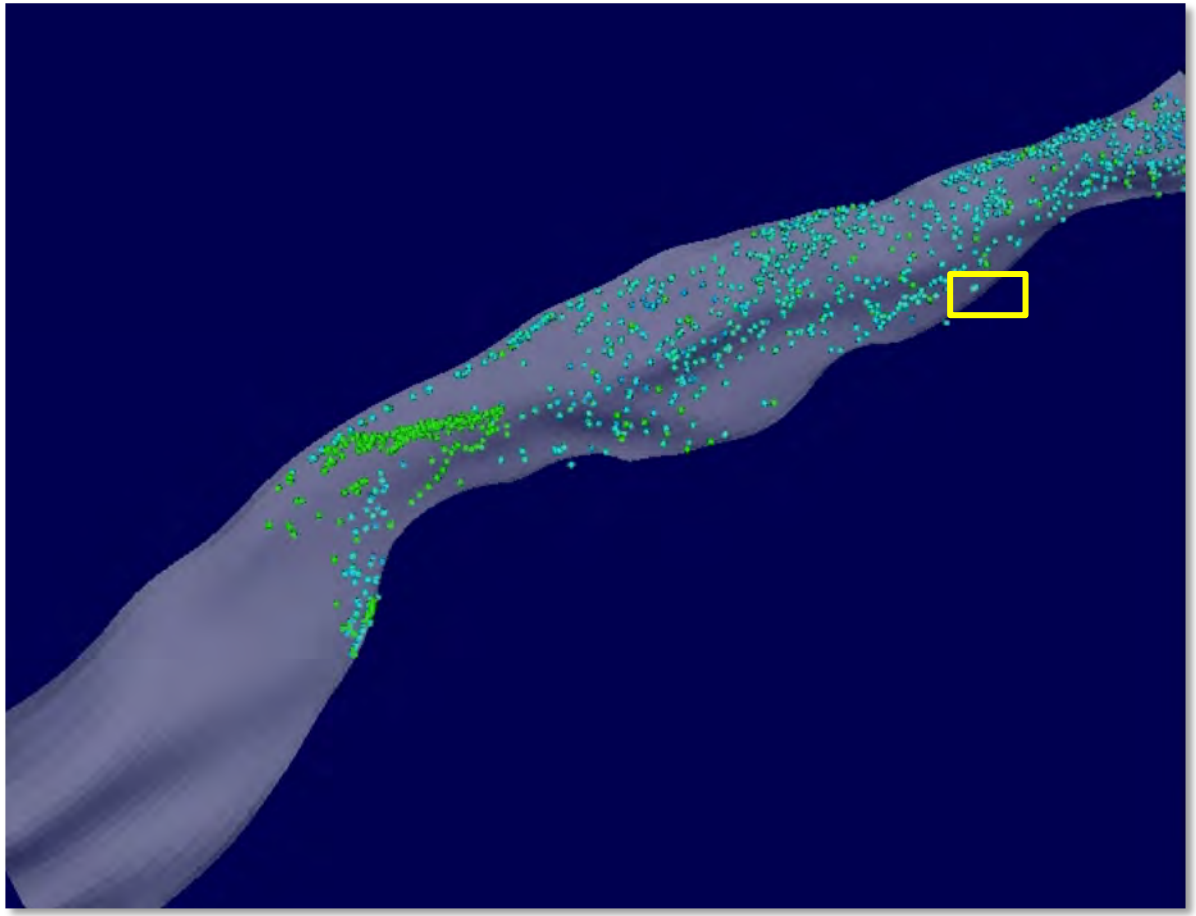
Can be used to study ancient or unseen processes.



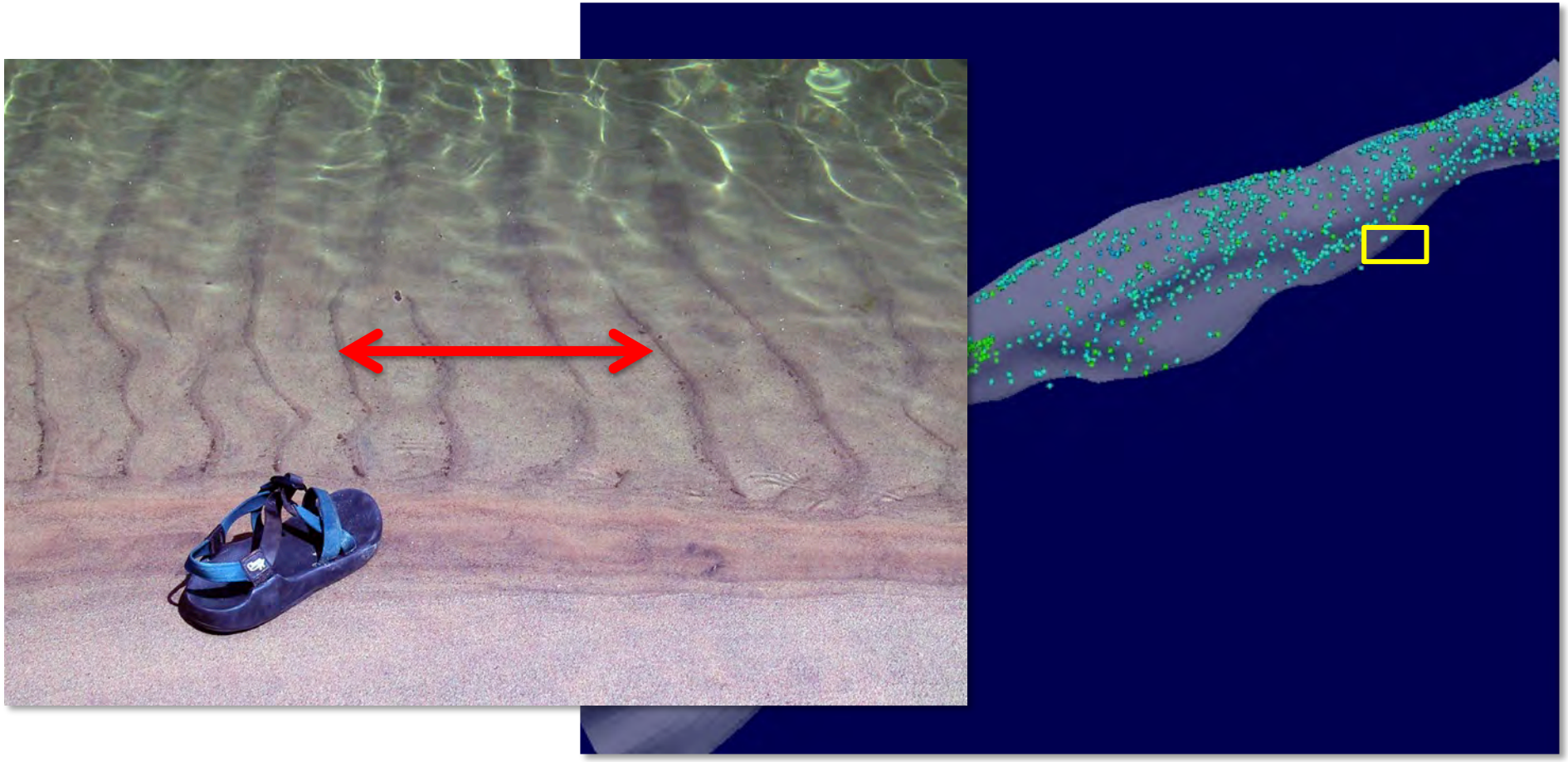
Easy to observe flow in the river.

But how can we interpret flows of floods that deposited sand bars exposed above water when we weren't there to watch?

Use sedimentary structures deposited by the past flows, as in examples in next slides.

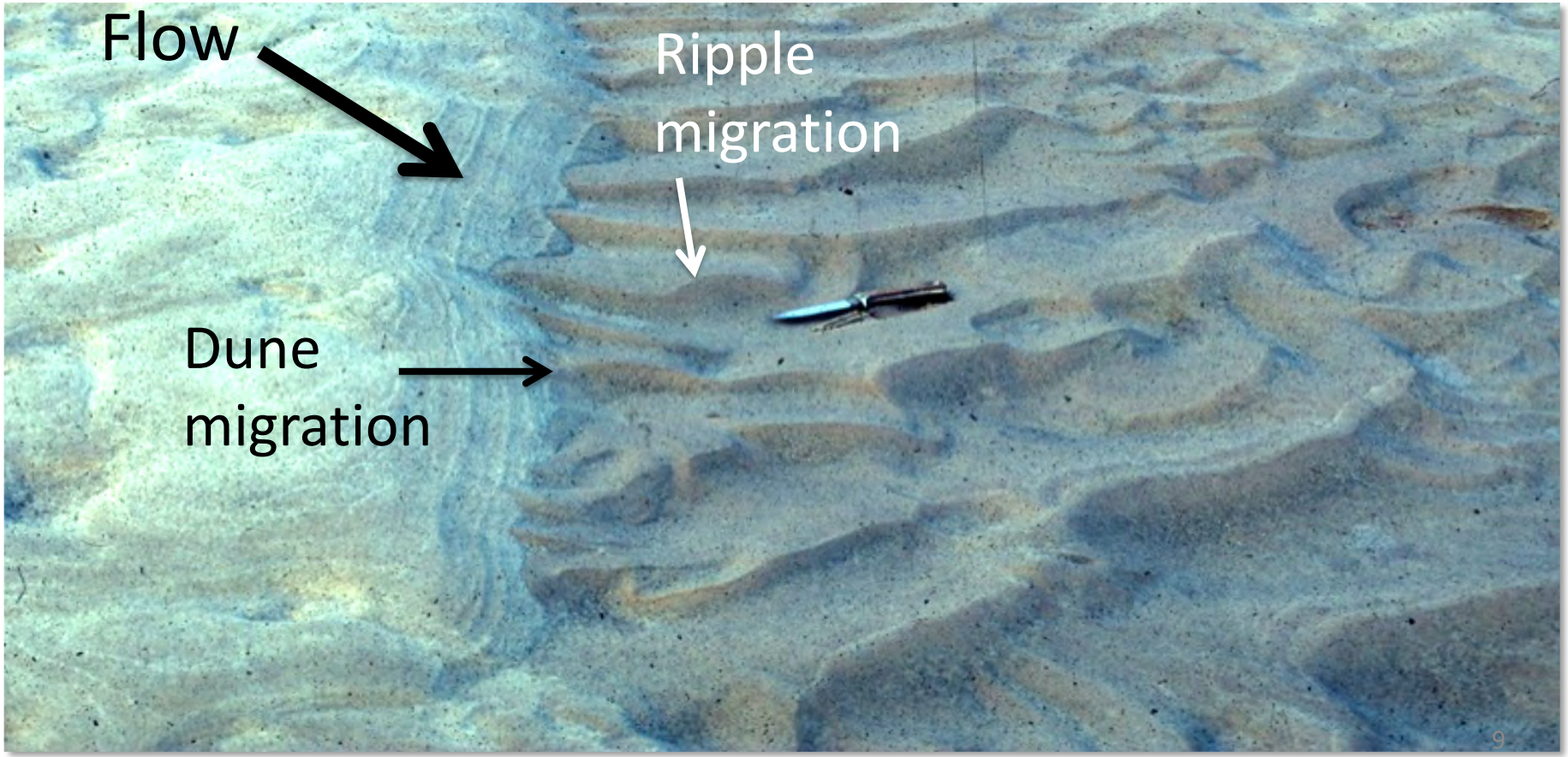


Animation: Schmeeckle and Akahori, Arizona State University.



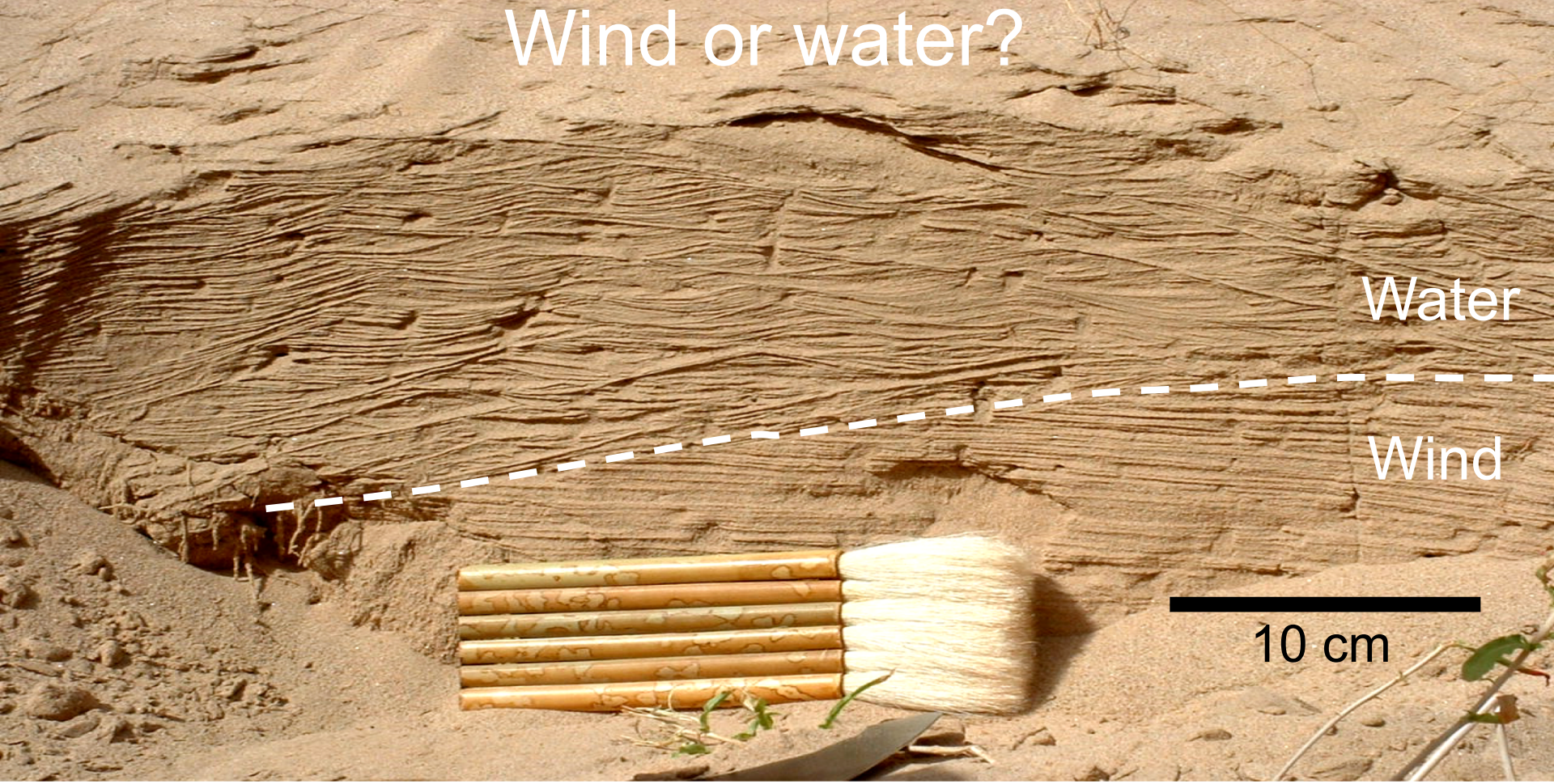
Animation: Schmeeckle and Akahori, Arizona State University.

Examine structures deposited by ripples and dunes when bar was underwater

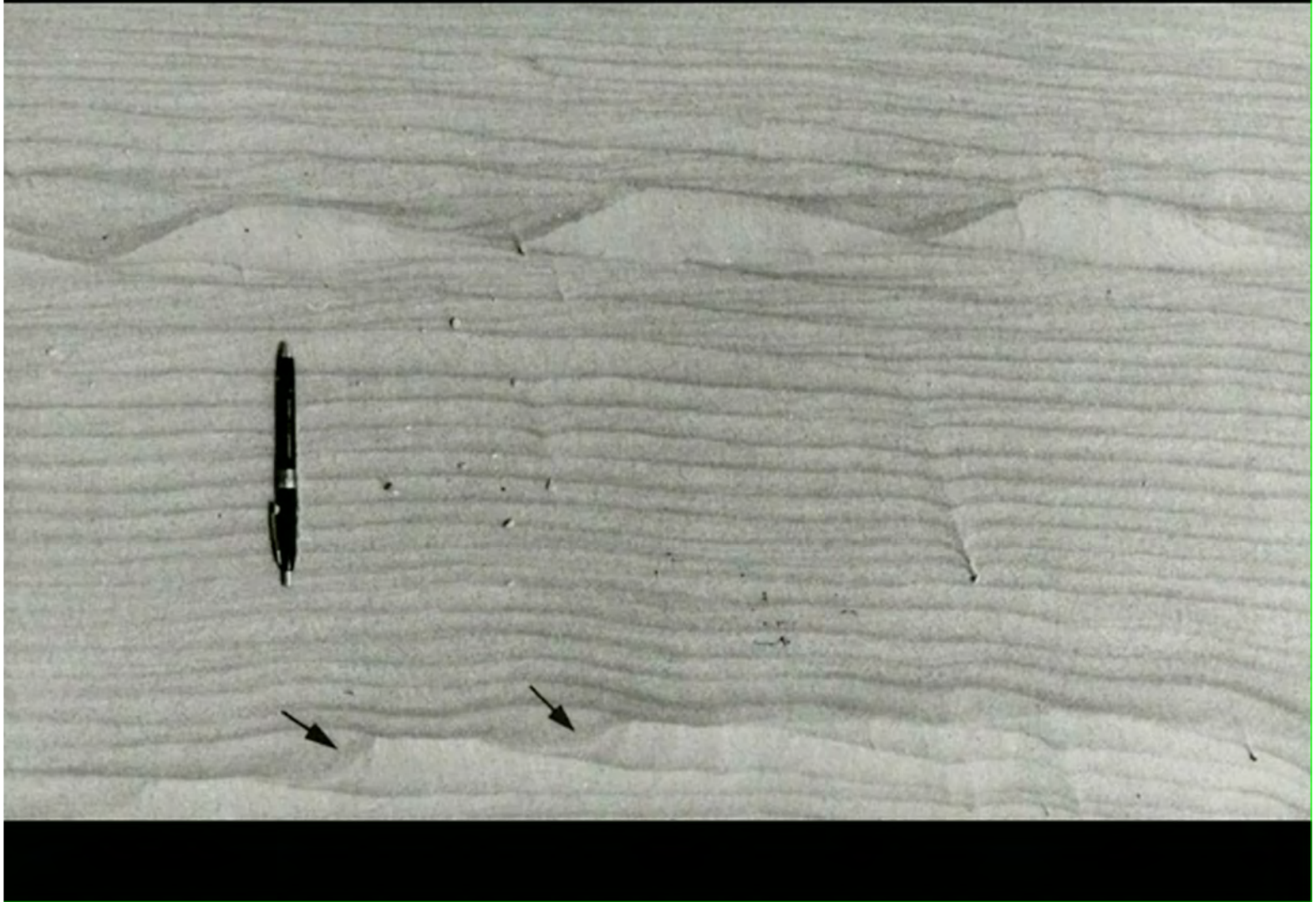


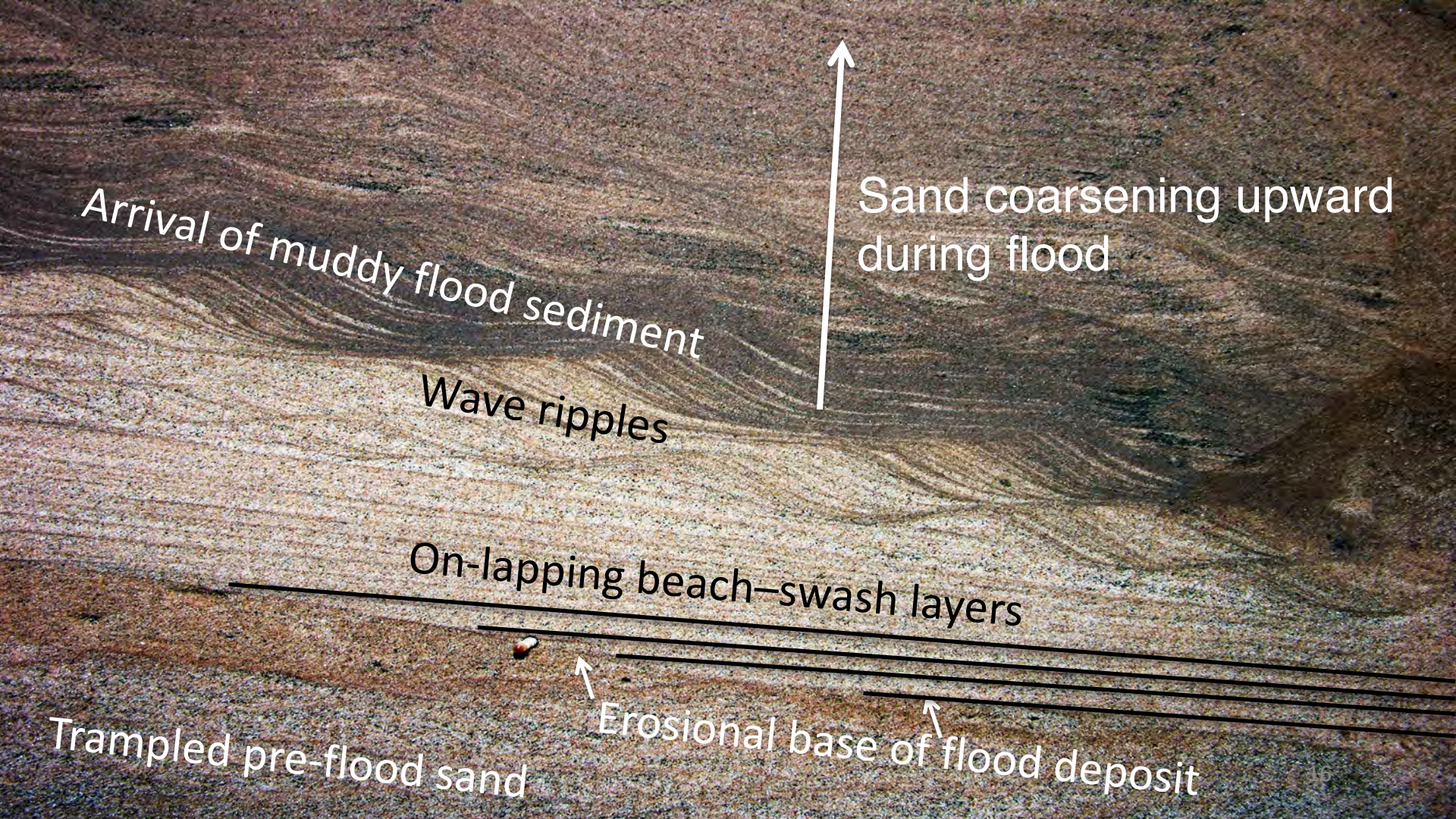

Deposition by wind
Erosion
Deposition by water or wind?

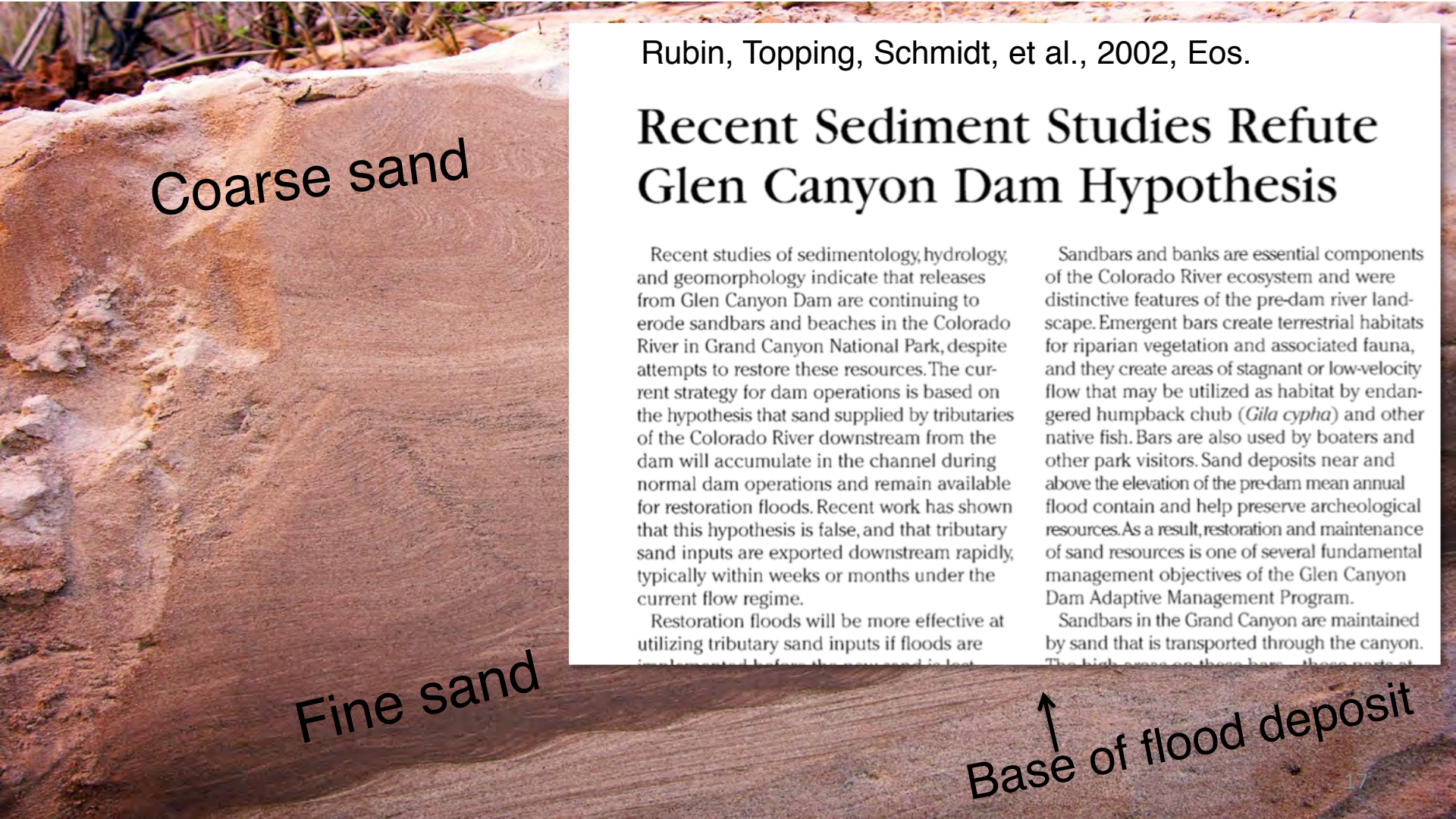
Wind or water?



Draut et al., 2005, USGS *Scientific Investigations Report*.




Arrival of muddy flood sediment
Wave ripples
Sand coarsening upward during flood
On-lapping beach–swash layers
Trampled pre-flood sand
Erosional base of flood deposit



Rubin, Topping, Schmidt, et al., 2002, Eos.

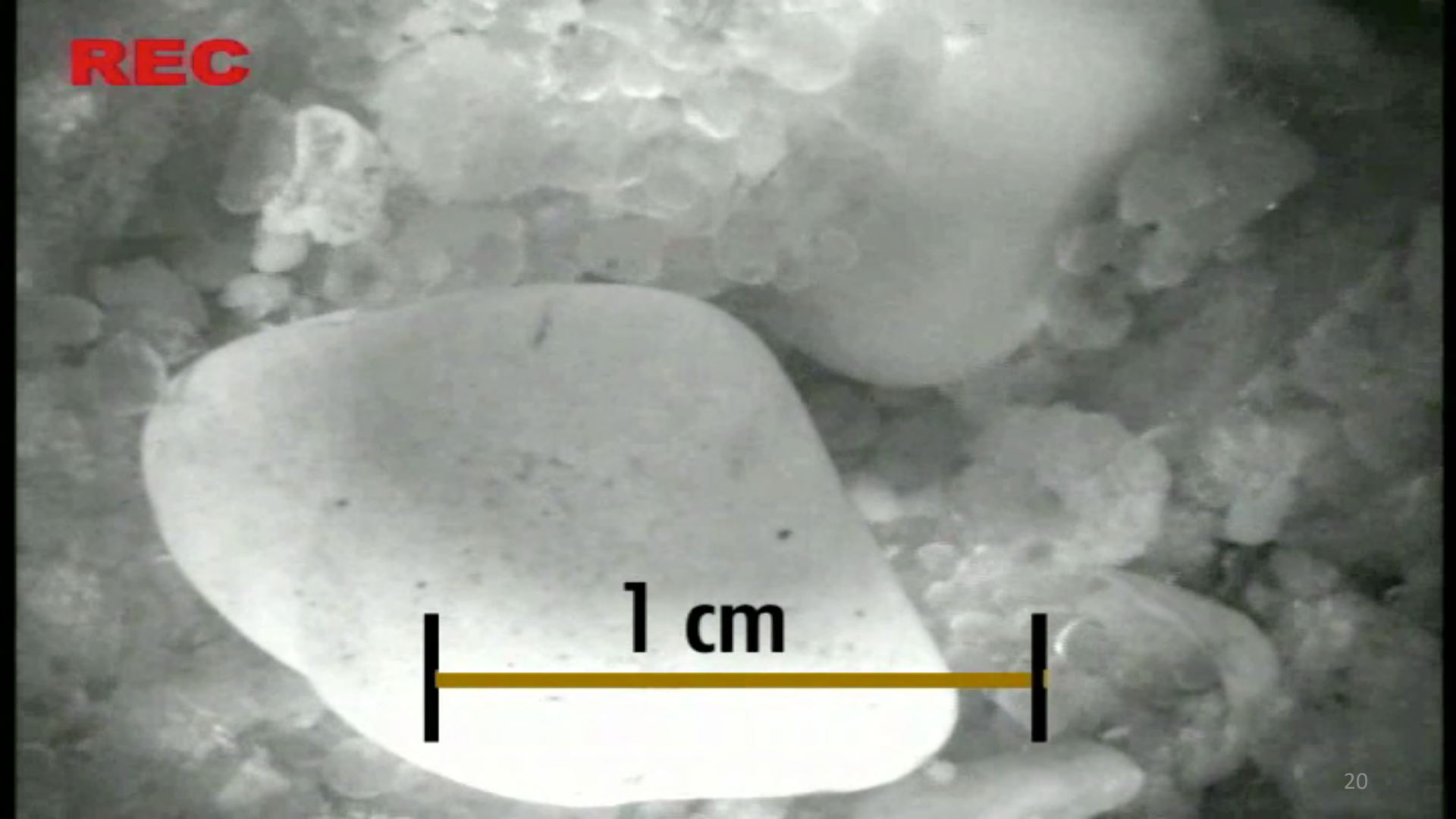
Recent Sediment Studies Refute Glen Canyon Dam Hypothesis

Recent studies of sedimentology, hydrology, and geomorphology indicate that releases from Glen Canyon Dam are continuing to erode sandbars and beaches in the Colorado River in Grand Canyon National Park, despite attempts to restore these resources. The current strategy for dam operations is based on the hypothesis that sand supplied by tributaries of the Colorado River downstream from the dam will accumulate in the channel during normal dam operations and remain available for restoration floods. Recent work has shown that this hypothesis is false, and that tributary sand inputs are exported downstream rapidly, typically within weeks or months under the current flow regime.

Restoration floods will be more effective at utilizing tributary sand inputs if floods are

Sandbars and banks are essential components of the Colorado River ecosystem and were distinctive features of the pre-dam river landscape. Emergent bars create terrestrial habitats for riparian vegetation and associated fauna, and they create areas of stagnant or low-velocity flow that may be utilized as habitat by endangered humpback chub (*Gila cypha*) and other native fish. Bars are also used by boaters and other park visitors. Sand deposits near and above the elevation of the pre-dam mean annual flood contain and help preserve archeological resources. As a result, restoration and maintenance of sand resources is one of several fundamental management objectives of the Glen Canyon Dam Adaptive Management Program.

Sandbars in the Grand Canyon are maintained by sand that is transported through the canyon.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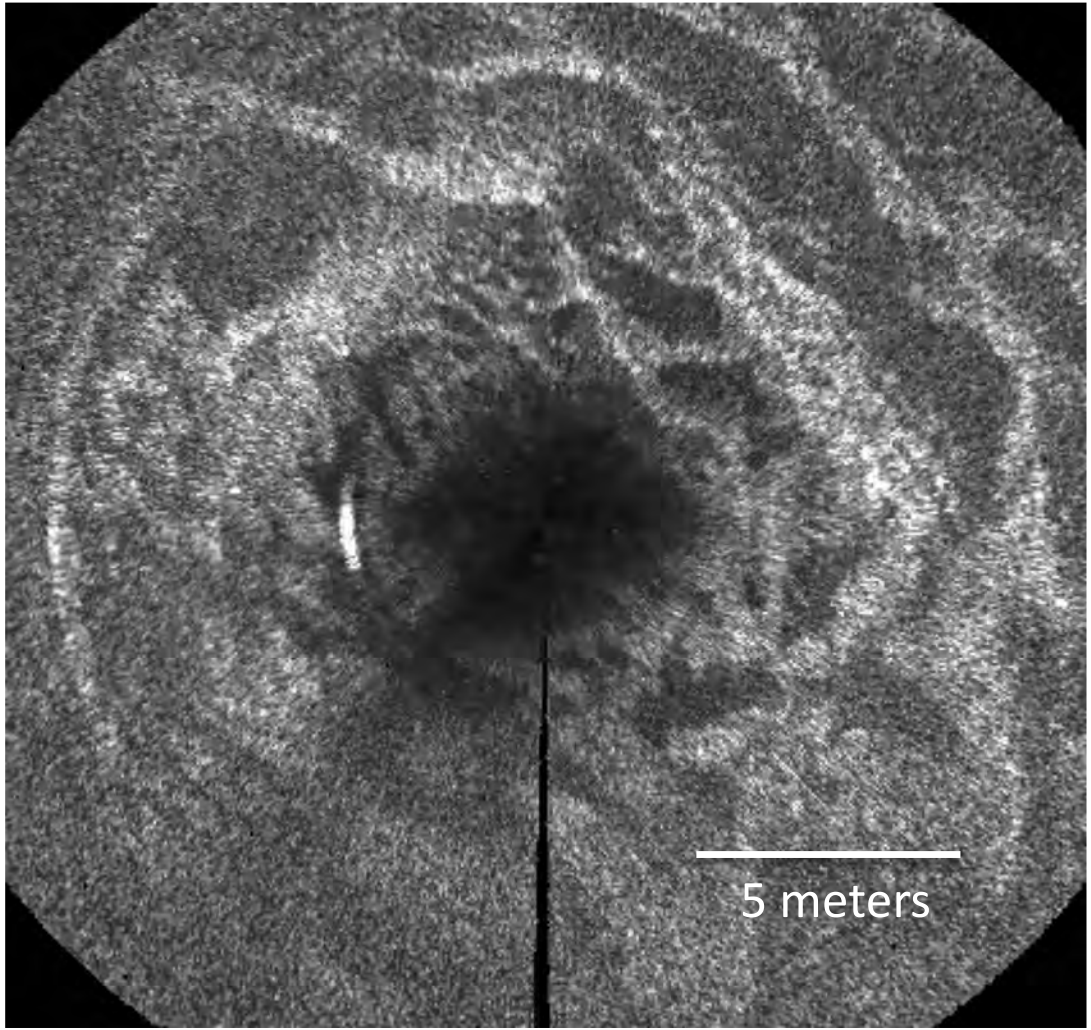
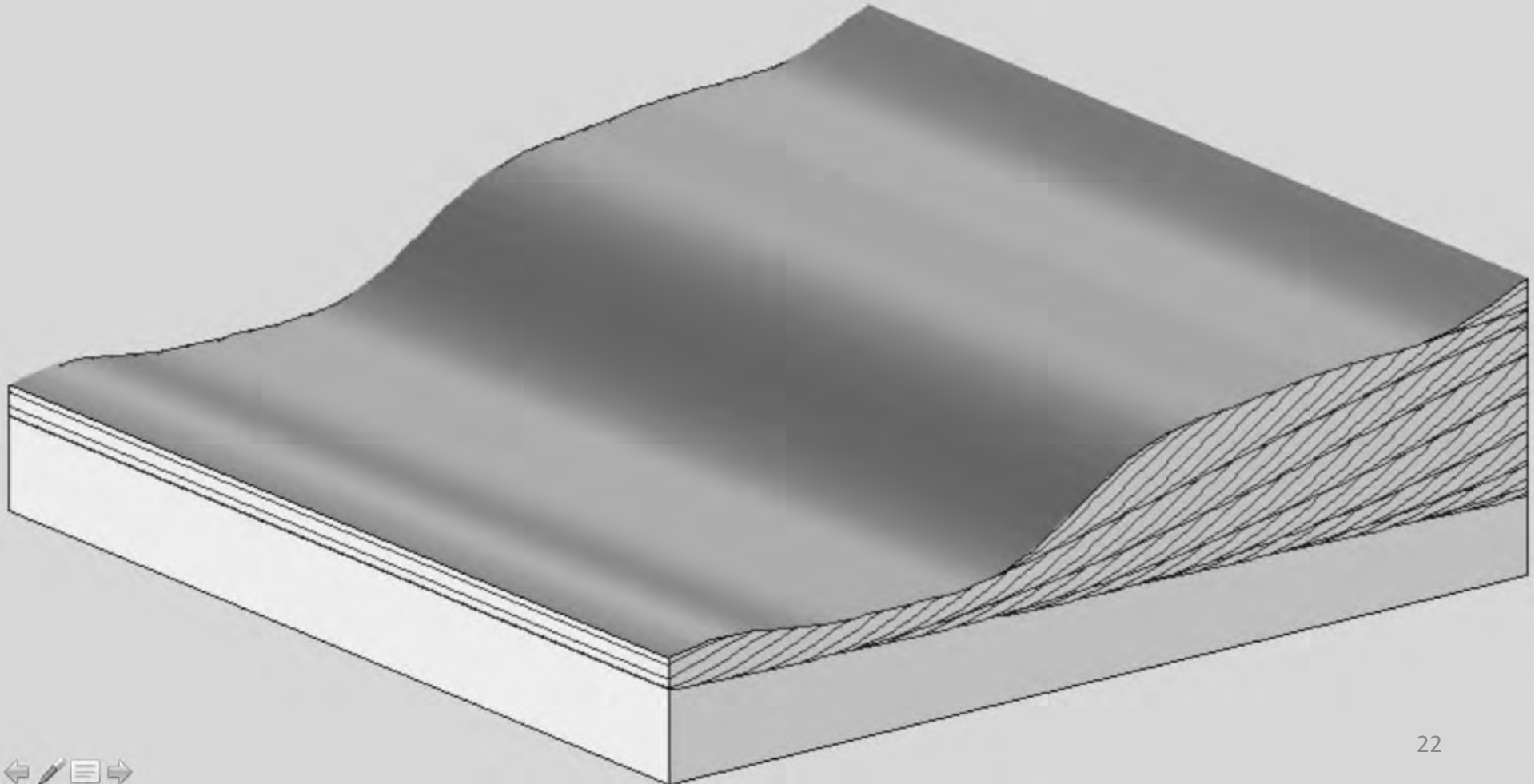
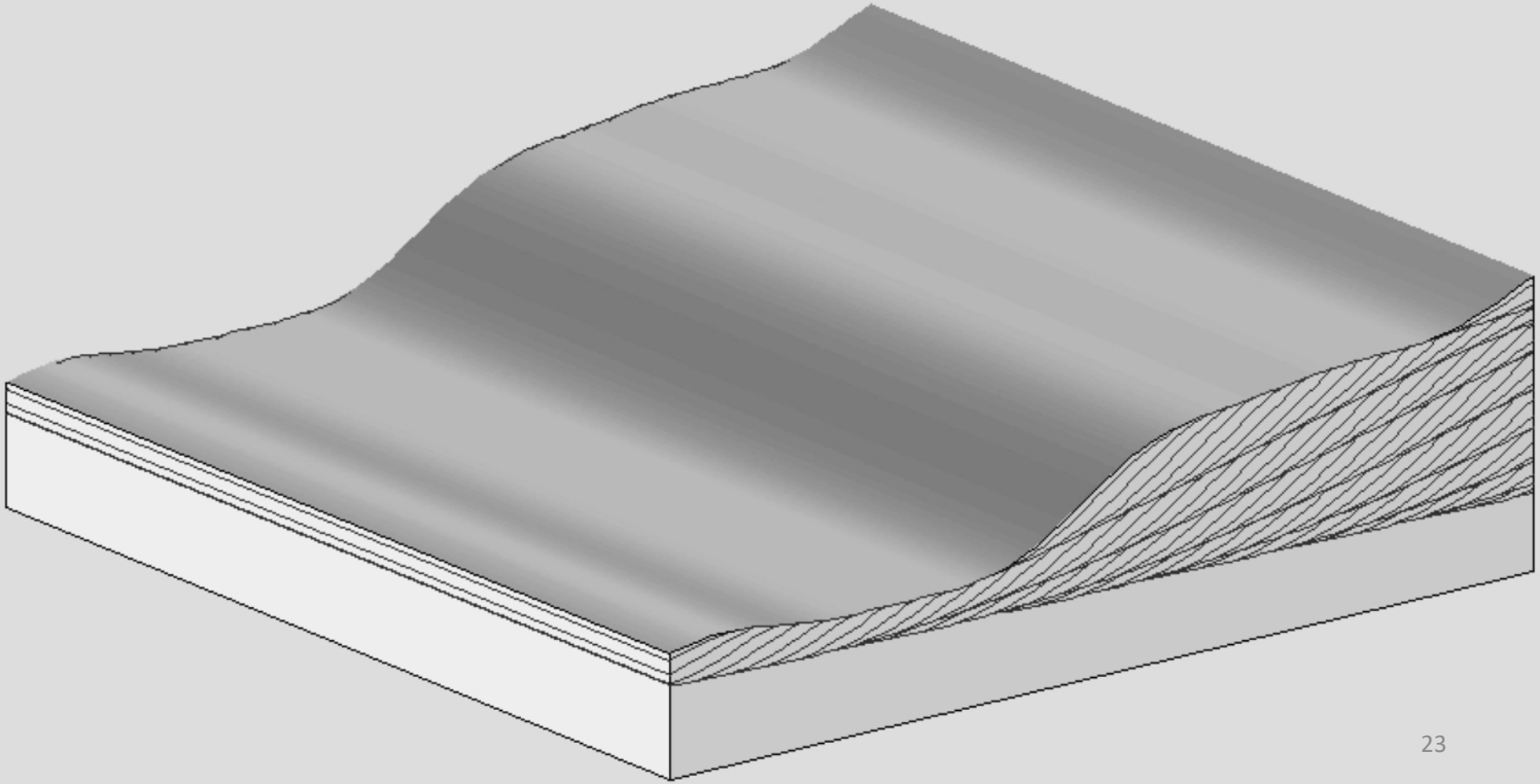
1 cm

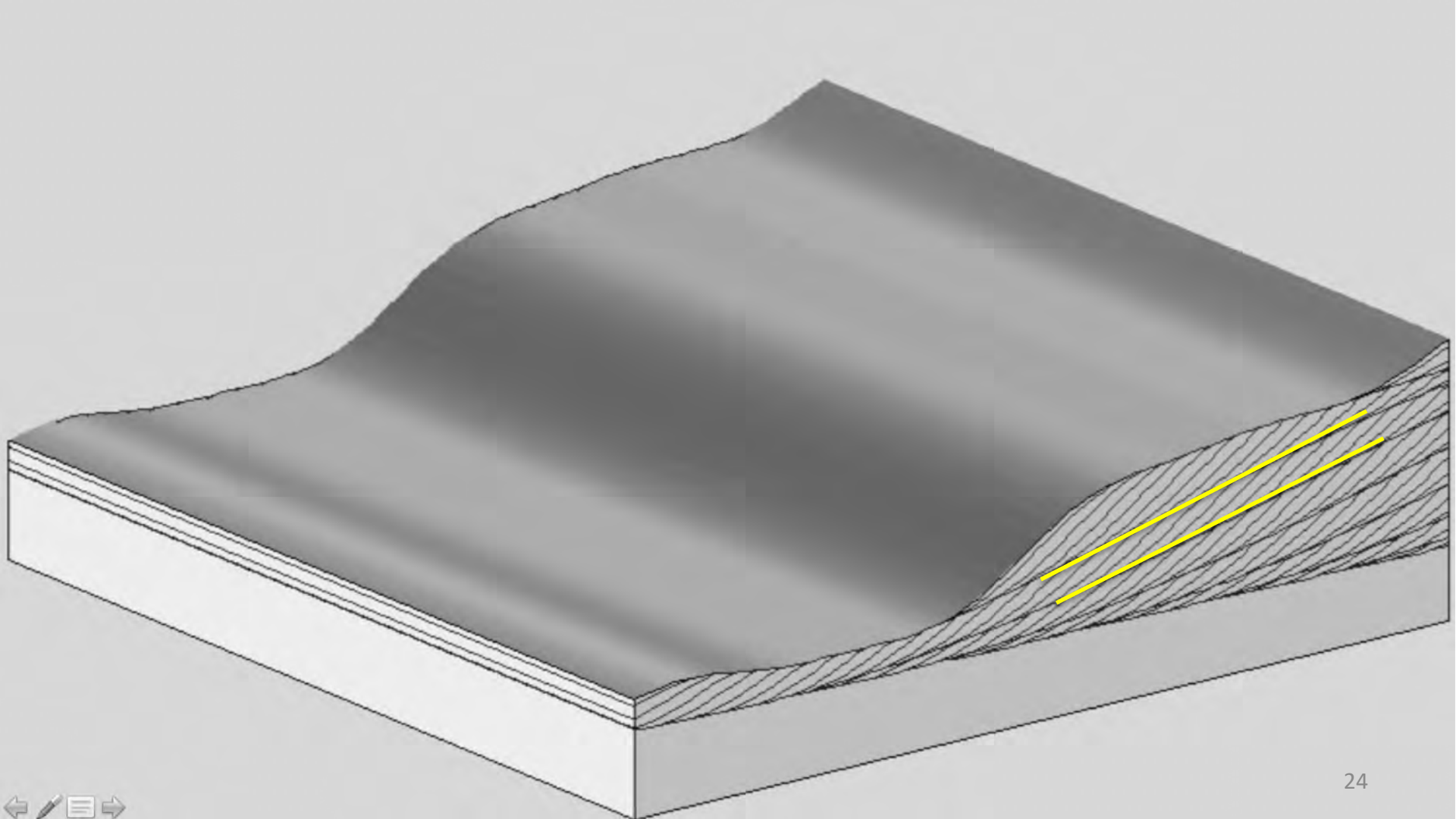


Underwater sonar time-lapse movie of underwater dunes migrating over a sand bar in the Colorado River.

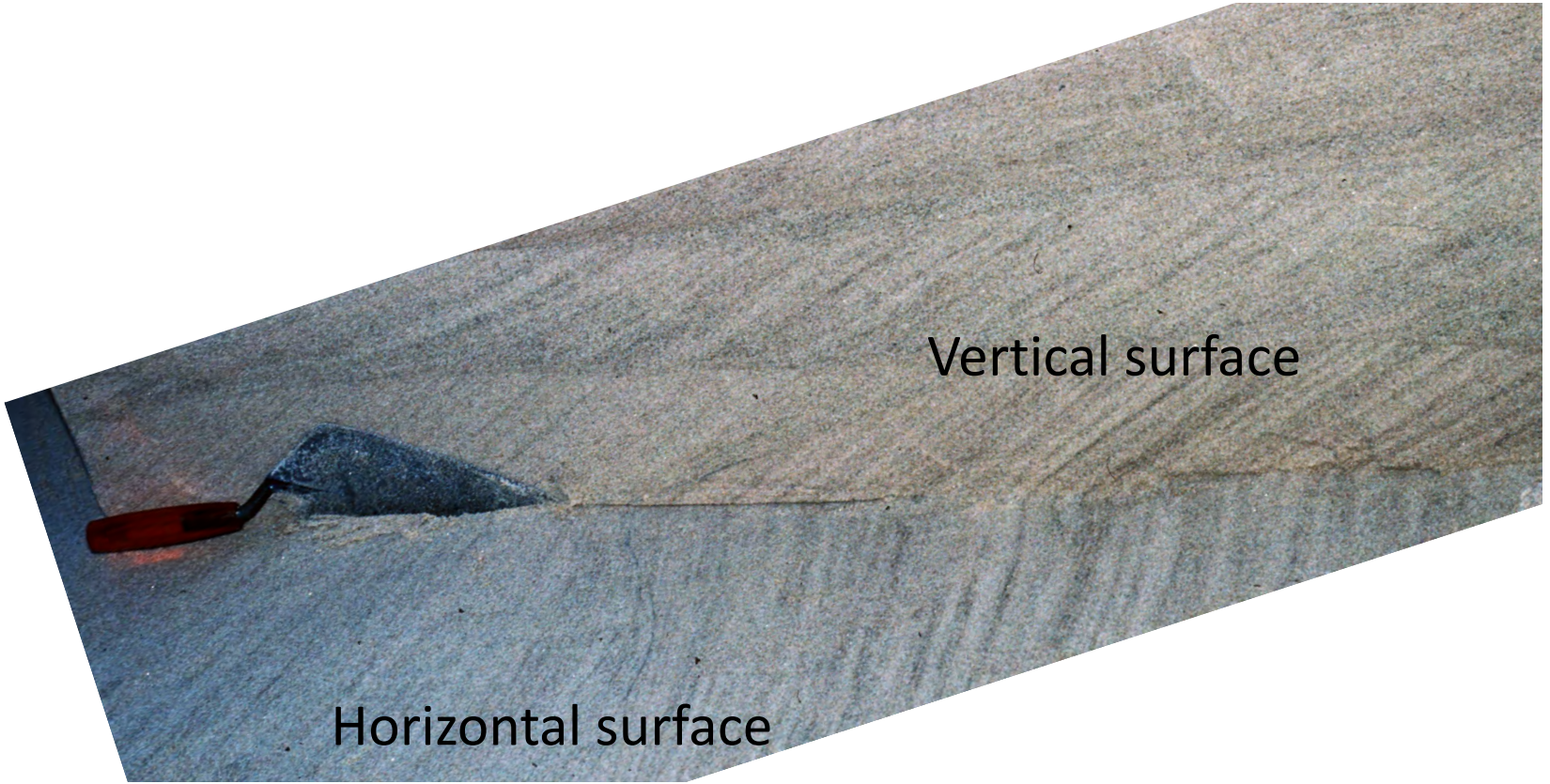
Approximately 16 hours compressed into 15 seconds.

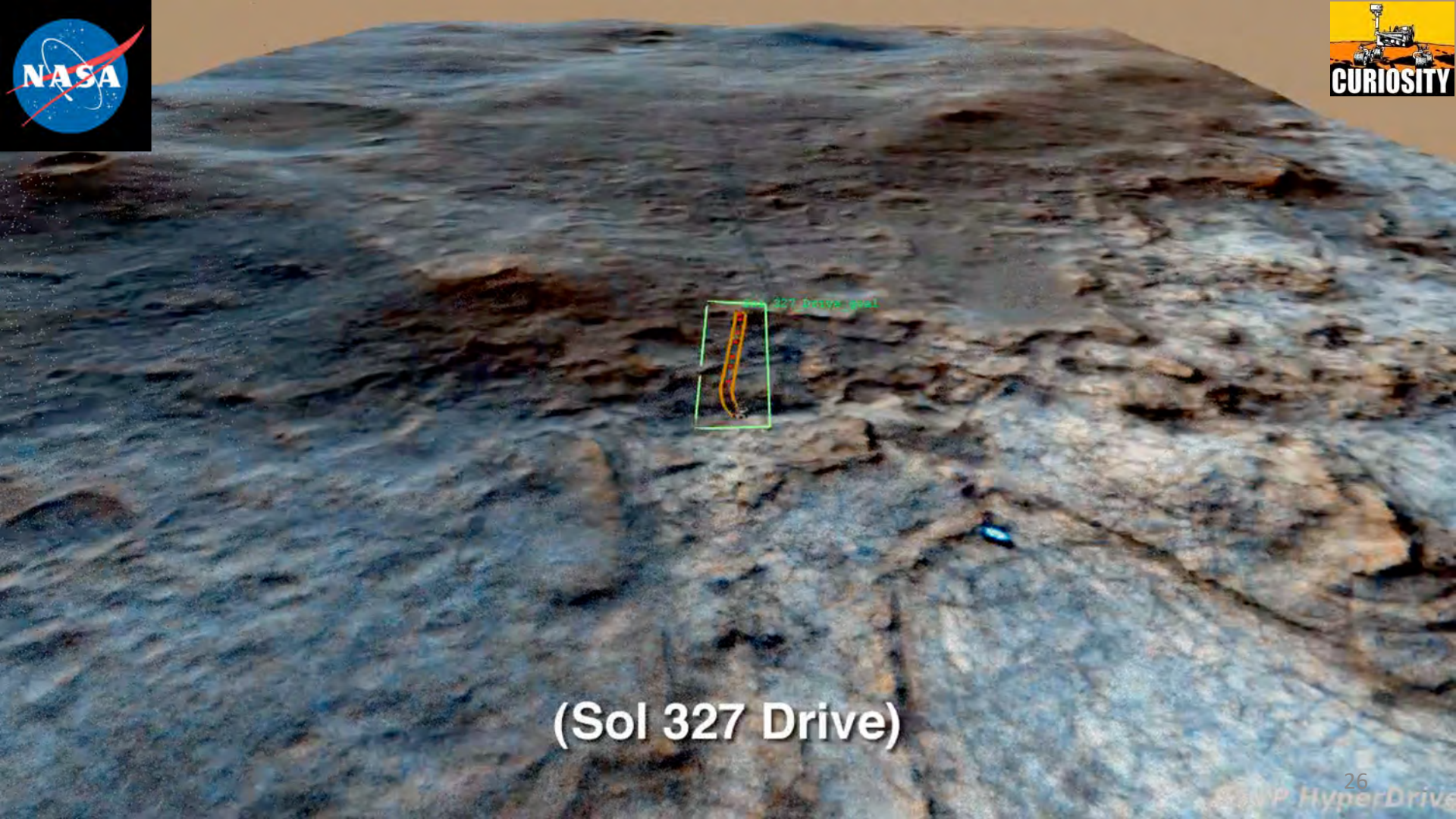






Structure deposited by underwater dunes in Colorado River in Grand Canyon




NASA
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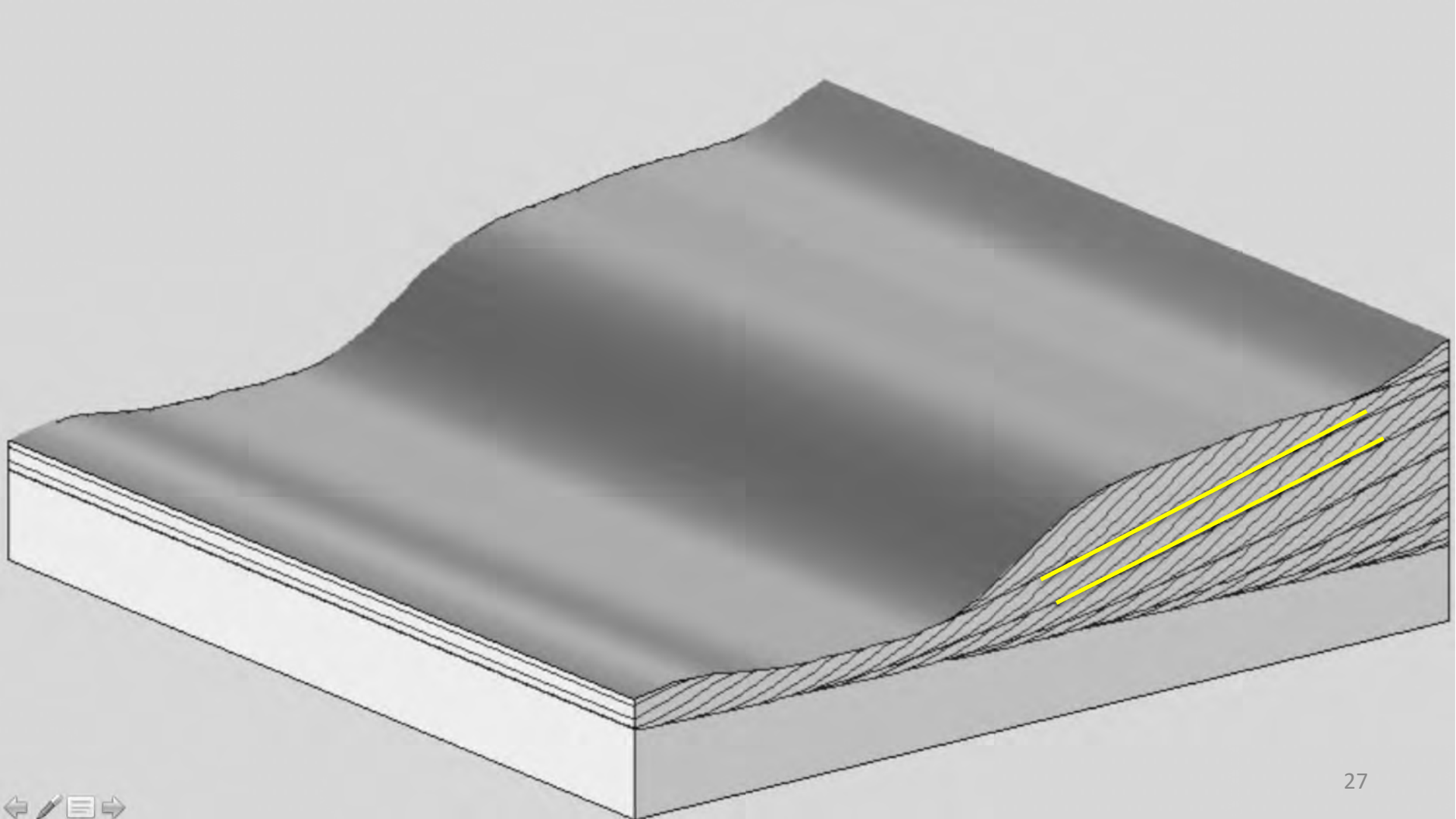

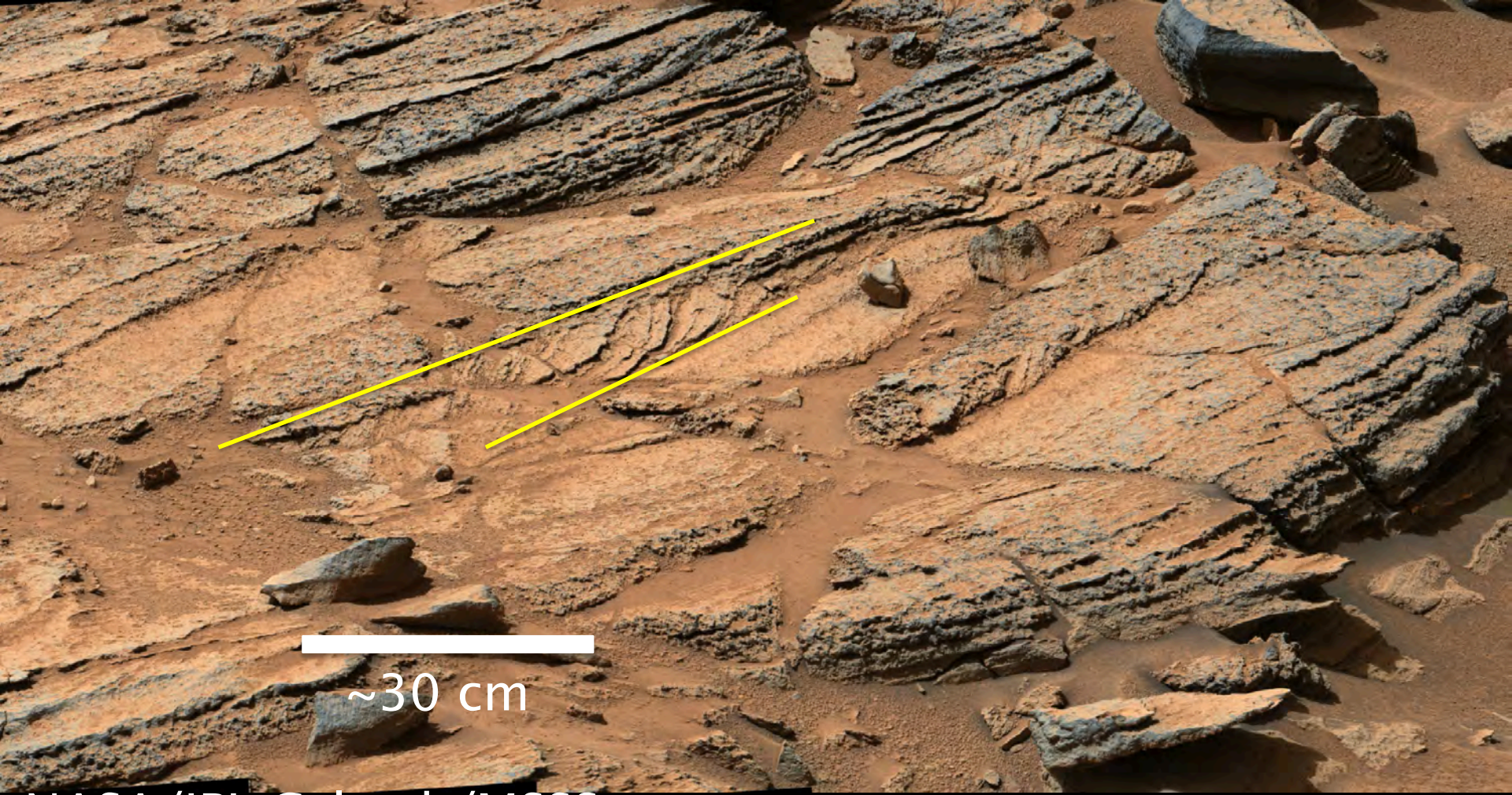

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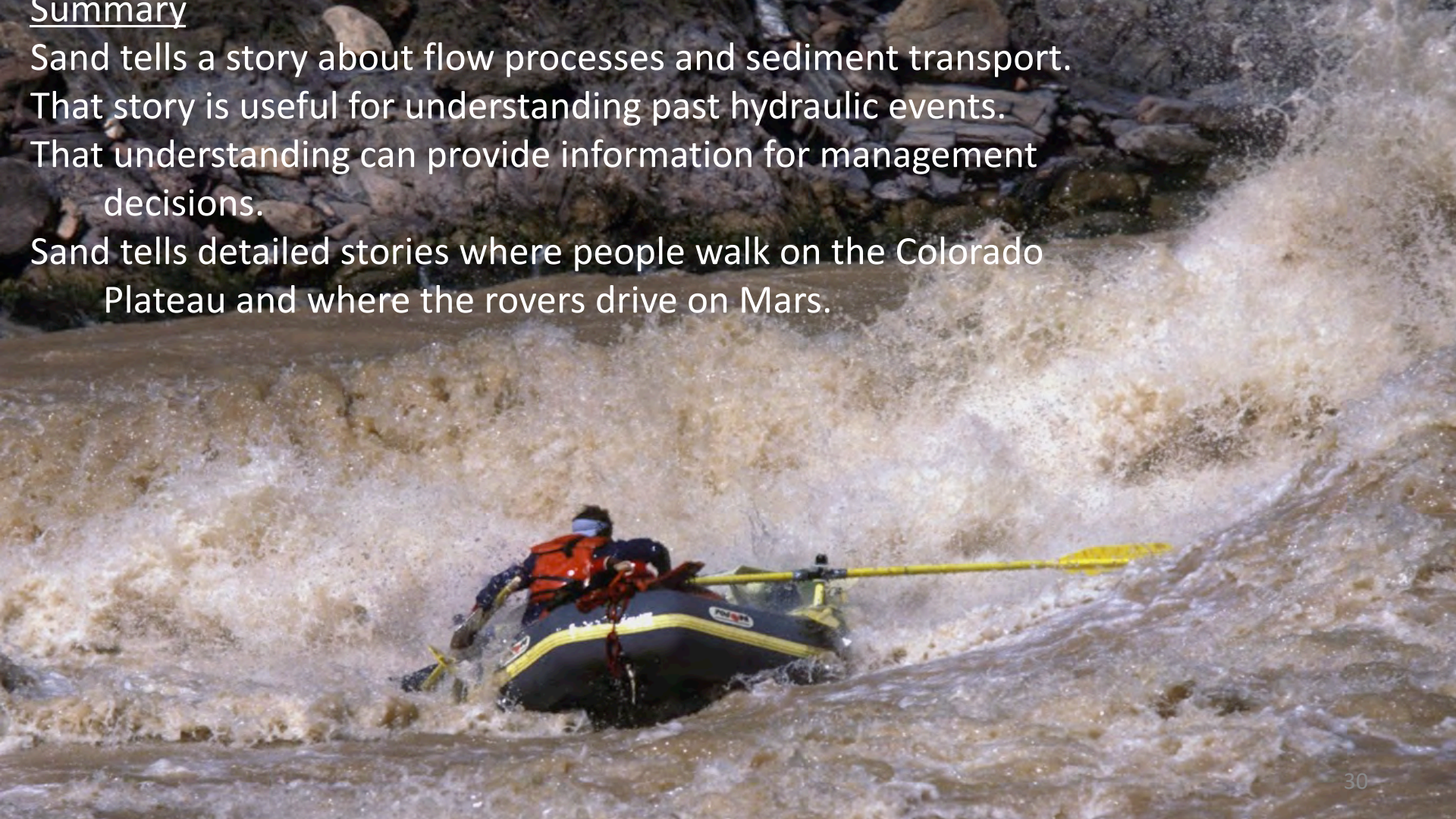


Summary

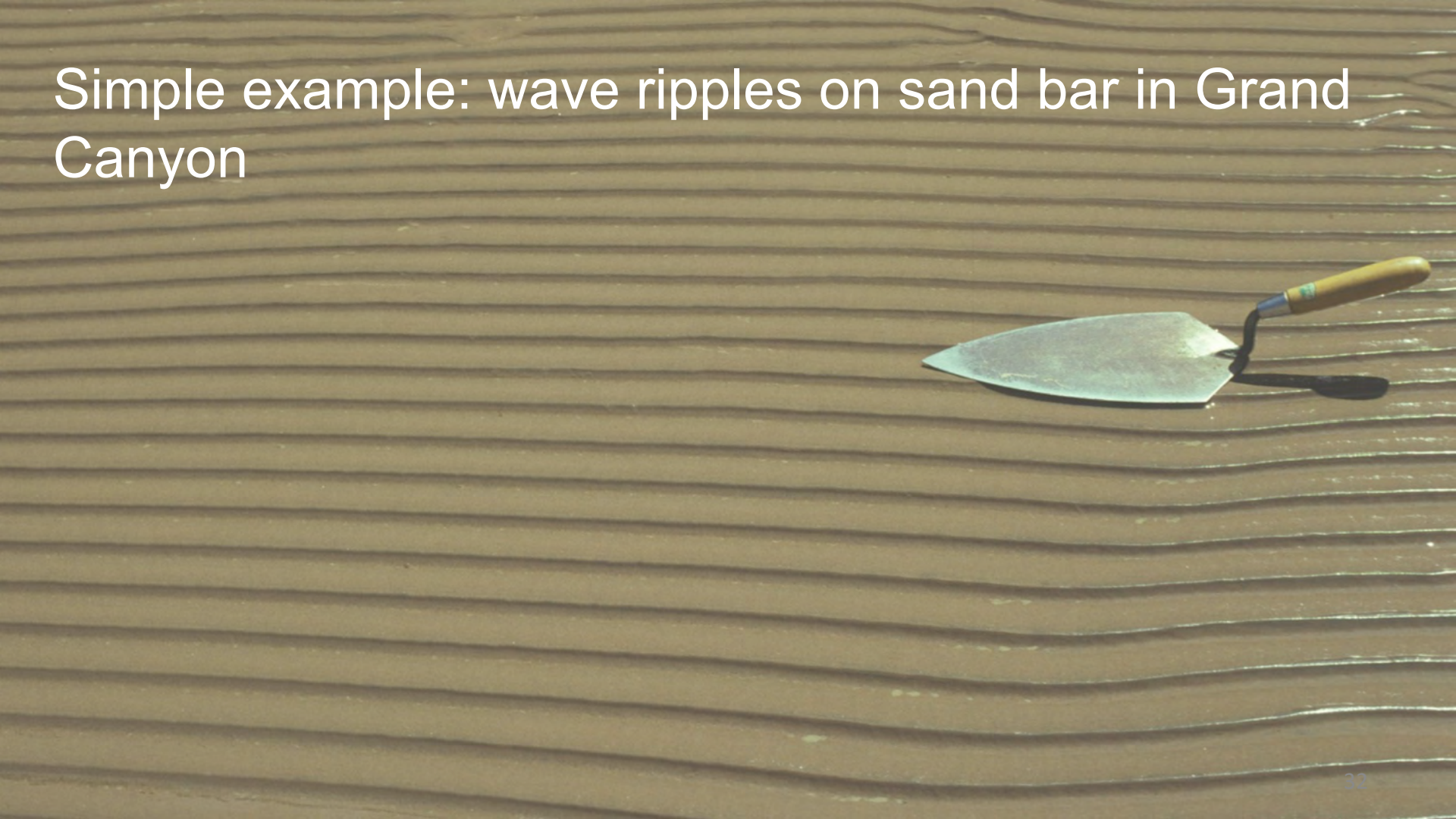
Sand tells a story about flow processes and sediment transport.

That story is useful for understanding past hydraulic events.

That understanding can provide information for management decisions.

Sand tells detailed stories where people walk on the Colorado Plateau and where the rovers drive on Mars.

Simple example: wave ripples on sand bar in Grand Canyon



Ancient analog: wave ripples from Triassic Moenkopi Formation in southern Utah