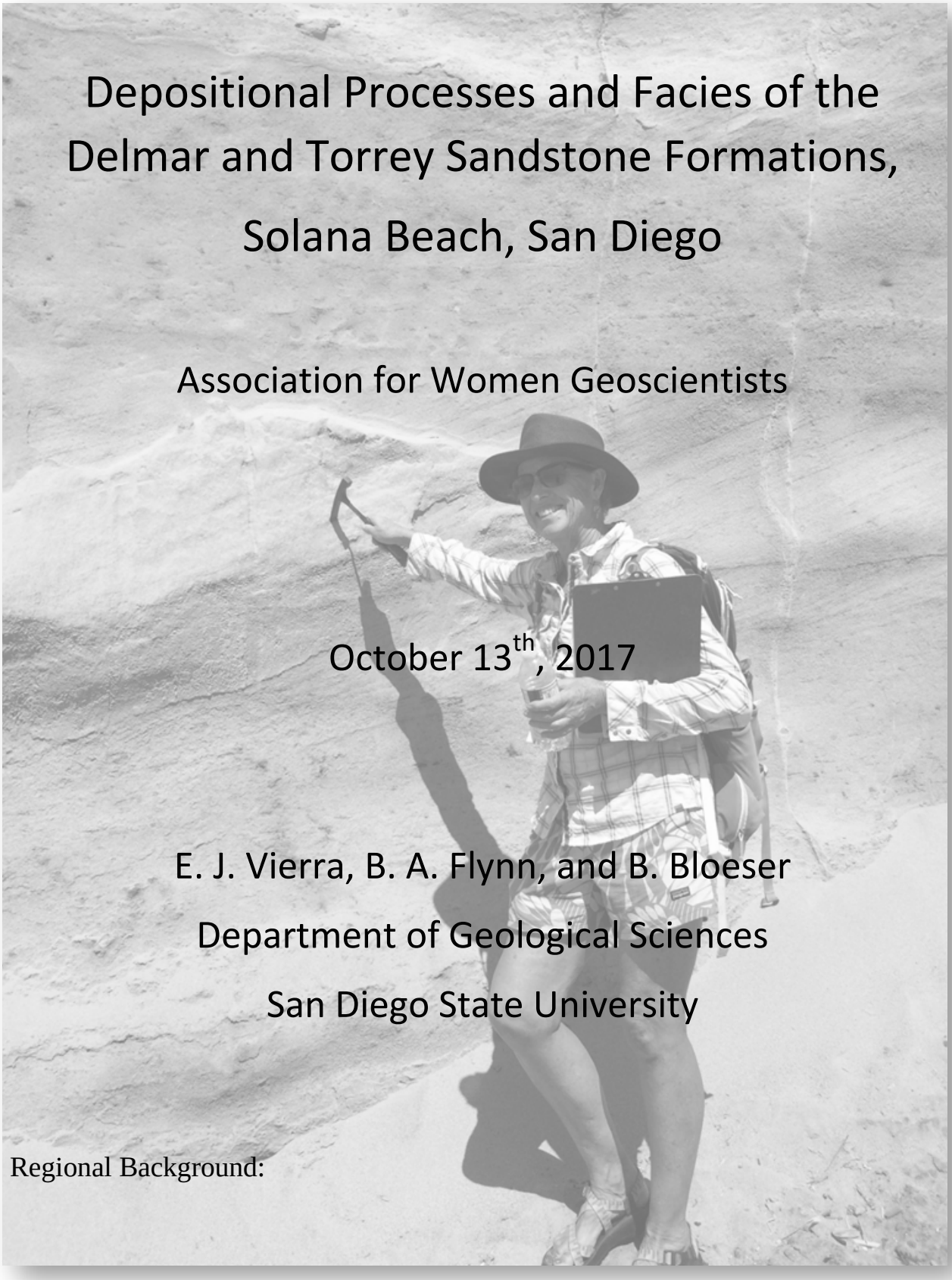
Depositional Processes and Facies of the Delmar and Torrey Sandstone Formations, Solana Beach, San Diego

Association for Women Geoscientists



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Regional Background:

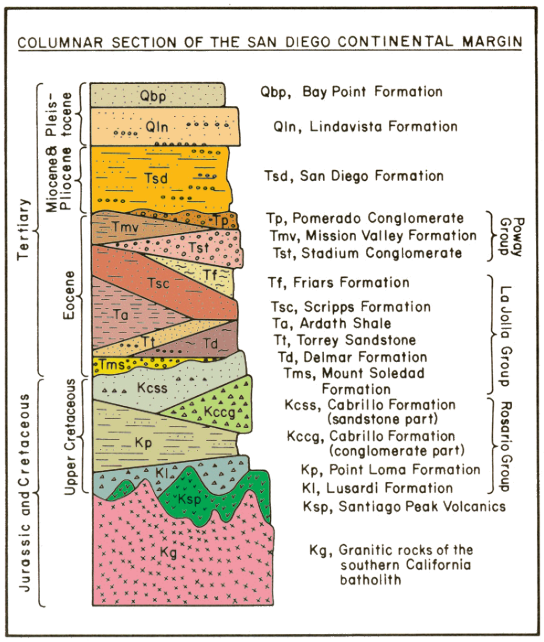


Fig. 1: Strat column of San Diego continental margin

Delmar Formation

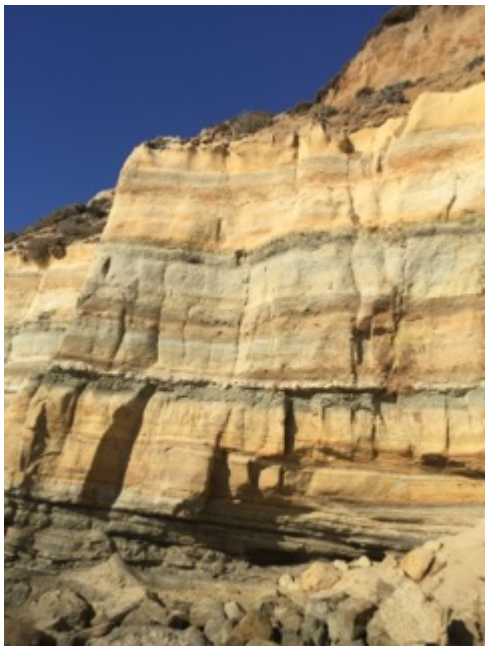
The Eocene Delmar Formation was deposited in a lagoonal environment, full of life, resulting in the preservation of abundant fossils and ichnofossils (trace fossils). The formation is composed of greenish-yellow mudstones and siltstones with sandstone beds up to 3 meters thick. At the base of the formation is a fossiliferous unit composed entirely of oyster shells. This unit protrudes along several sections of the beach and is well exposed and preserved as a resistant unit.

Features to recognize within the Delmar Formation include: cross-bedding, fossil rich beds, differential weathering, desiccation cracks, coal lenses, and trace fossils (bioturbation). Look for these key features throughout the trip!

Torrey Sandstone

Stratigraphically above the Delmar Formation is another Eocene deposit, the Torrey Sandstone. The rocks within this formation were deposited as sandbars in a marine environment. The originally unconsolidated sands were cemented by calcite from water flowing through the sand. Light orange surficial staining is often observed due to the presence of iron oxide from the overlying Pleistocene Lindavista Fm. terrigenous rocks.

Features to recognize within the Torrey Sandstone include: cross-bedding, iron oxide staining, normal faults, amalgamated stacked sandwaves, regional erosion, and concretions. Look for these key features throughout the trip!



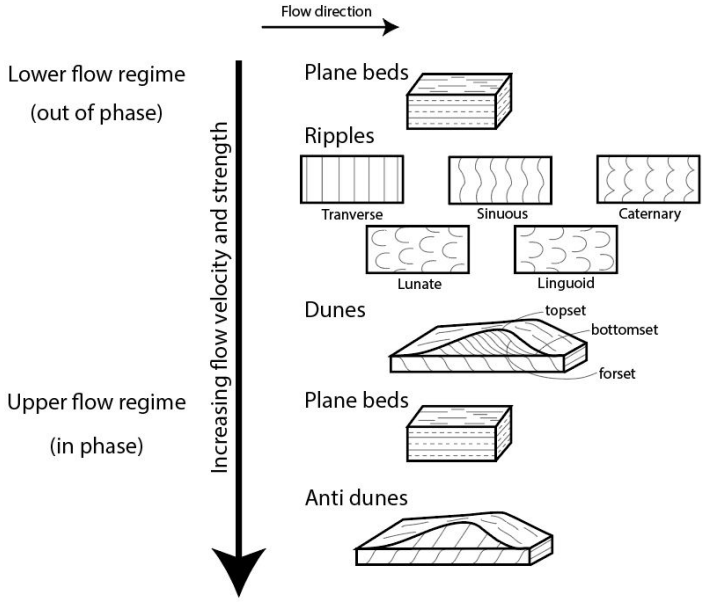
unconformity

Lindavista Formation

Stratigraphically above the Torrey Sandstone is the Pleistocene Lindavista Formation. An unconformity separates the Lindavista from the Torrey Sandstone, representing a time gap of approximately 30 million years. The Lindavista represents a continental deposit of reddish siltstones and sandstones with localized conglomerates in a fluvial environment. Often seen in the hillslopes of the Lindavista Formation are rills, shallow channels that develop from runoff which erode the formation.

Features to recognize within the Lindavista Formation include: rills and an unconformity. Look for these key features throughout the trip!

Fig. 2: Unconformity between the Torrey Sandstone and Lindavista Formation



Field Stop 1: Flow regimes

1. Recognize and examine the following sedimentary features in differing flow regimes:

2. How many different types of ripples can you see? In which flow regime are they found?

3. Seeing these sedimentary features in the present can help us determine what happened in the past - the theory of *uniformitarianism* – "the present is the key to the past".

Figure 3: Sedimentary structures associated with changes in velocity and flow strength.

Field Stop 2: Delmar Fm.

1. Observe the characteristics of the Delmar Formation at this stop.

2. The oyster bed facies of the Delmar Fm. represent the basal section at this stop. Why do the oyster beds protrude farther than the overlying sandstones and mudstones? Are these oyster beds *in situ*?

3. Above the Torrey Sandstone is the Lindavista Formation. Is there an obvious feature that separates the Lindavista Fm. from the Torrey Sandstone?

Fig. 4: Differential erosion between the oyster beds, tidal flats, channel and creek facies is observed in the Delmar Fm.

Along the way:

1. Where is the contact between the Delmar Formation and the Torrey Sandstone Formation?

   - possible regional unconformity

Fig. 5: Desiccation cracks in sandstone with iron oxide staining

2. Notice how the outcrop becomes younger as you walk north

   - northward prograding clinoforms

3. Desiccation cracks

- subaerial exposure, tidal-flat facies within Delmar Fm.

4. Cementation

- iron oxide

- concretions

5. *Lam-scram* within tidal channel fill of Delmar Fm - bottom of bed is laminated or cross-bedded, which becomes dominated by more abundant and smaller trace fossils (burrows) upward with heavy bioturbation at the top. *Lam-scram* can indicate periods of high deposition followed by much slower rates of deposition.

Fig. 6: *Lam-scram* within the Delmar Fm.

Field Stop 3: Trace fossils

1. Recognize and examine the following shallow marine trace fossils:

- *Ophiliomorpha*

- *Gyrolithes*

2. Notice that many of the burrows are lined with mud or cemented in some fashion. What kind of animals do you think made these burrows?

3. Are trace fossils more numerous in the Delmar Formation or the Torrey Sandstone? Why do you think that is?

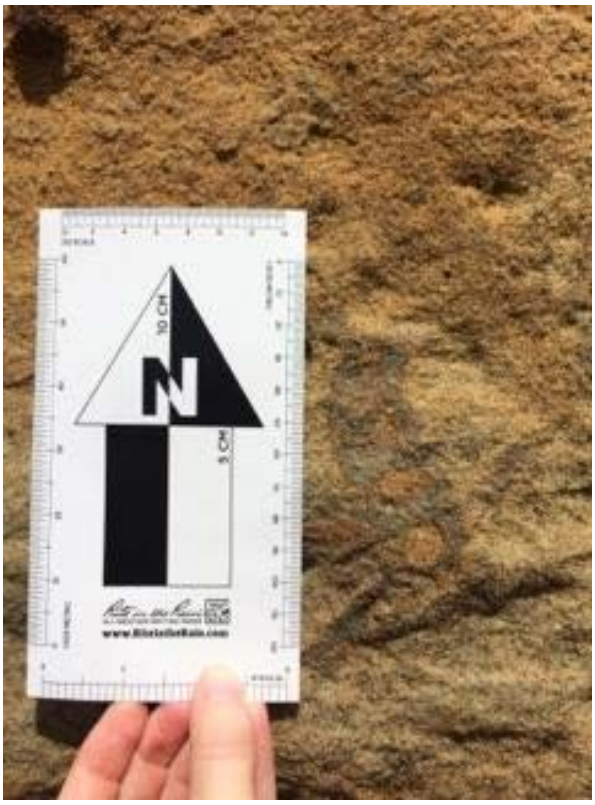


Fig. 7: *Gyrolithes*

Fig. 8: *Ophiliomorpha*

Field Stop 4: Sedimentology and Structure

1. Notice the heavily cross bedded facies of the Torrey Sandstone. Does the Torrey Sandstone represent a higher or lower energy environment compared to the Delmar Formation?

2. Recognize the following within the Torrey Sandstone:

- foreset bedding
- sandstone pinching out on either end of bed

3. Find evidence of faulting. What type of faults are these?

4. Look for regional erosion.

5. The outcrop represents a syncline with an E-W axis. The Delmar Fm. can be seen at the southern and northern ends with the younger Torrey Sandstone in the middle of the outcrop.

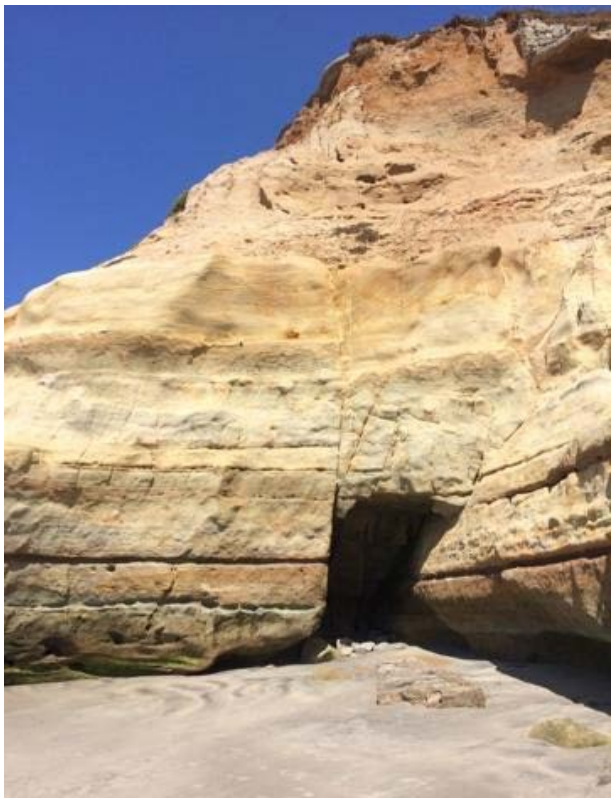


Fig. 9: B. Bloeser exhibiting cross-bedding within the Torrey Sandstone

Acknowledgements

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Fig. 10: Normal faulting

Reference: Abbott, P. L., and May, J. A., eds., 1991 Eocene Geologic History San Diego Region Pacific section SEPM, Vol 68, p. 39-54