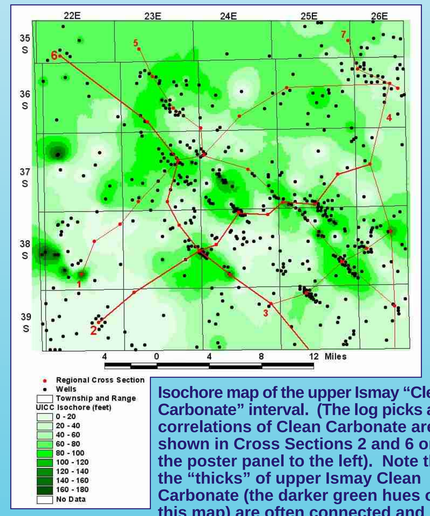
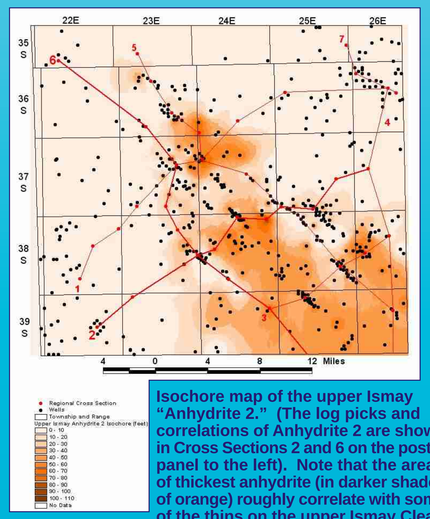
Isochore Relationships

Upper Ismay "Clean Carbonate" Isochore Map



Isochore map of the upper Ismay "Clean Carbonate" interval. (The log picks and correlations of Clean Carbonate are shown in Cross Sections 2 and 6 on the poster panel to the left). Note that the "thicks" of upper Ismay Clean Carbonate (the darker green hues on this map) are often connected and nearly surround "thins" (in very pale shades). The thicks are probably the combined effect of upper Ismay platform (Middle to Inner Shelf/Tidal Flat) deposition and organic (phylloid-algal and bryozoan) buildups. The thins surrounded by thicks are "intra-shelf basins" within the upper Ismay interval. These intra-shelf basins are filled with thick anhydrite deposits (see "Anhydrite 2" isochore map below). The remaining thins that are not surrounded by or in close proximity to thicks are largely open marine (deep, outer shelf) deposits.

Upper Ismay "Anhydrite 2" Isochore



Isochore map of the upper Ismay "Anhydrite 2." (The log picks and correlations of Anhydrite 2 are shown in Cross Sections 2 and 6 on the poster panel to the left). Note that the areas of thickest anhydrite (in darker shades of orange) roughly correlate with some of the thins on the upper Ismay Clean Carbonate isochore map above. The Anhydrite 2 thicks were deposited within semi-isolated intra-shelf basins.

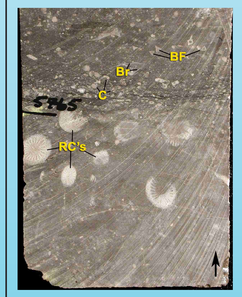
Isochore "Dilemma"

The isochore relationships shown on the maps above are too coarse or complex to accurately define prospective facies tracts and intra-shelf basin boundaries. Detailed examination of cores tied to wireline logs showed that the upper Ismay can be divided into two depositional sequences across the study area. We have termed these packages the "upper part" and "lower part" of the upper Ismay. The top of the Lower Part is frequently capped with an exposure or an erosional surface. The two maps on the next panel show the result of core and log interpretations for these two packages.

Major Facies Mapped in the Upper Ismay Zone

Seven depositional facies, interpreted from upper Ismay cores, have been recognized across the study area.

Open Marine



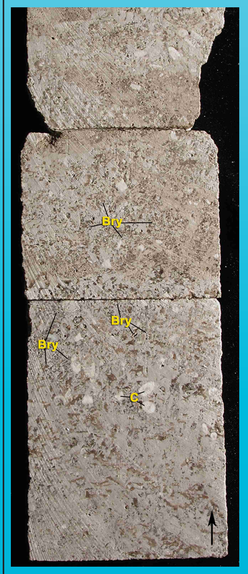
◀ 1-28 Cuthair
(28 - 38S - 22E)
5765 ft.

Lime muds containing well-preserved rugose corals (RC), crinoids (C), brachiopods (Br), bryozoans (Bry), and benthic forams (BF) are indicative of normal marine salinities and low-energy conditions.

1-28 Cuthair ▶
(28 - 38S - 22E)
5770 ft.

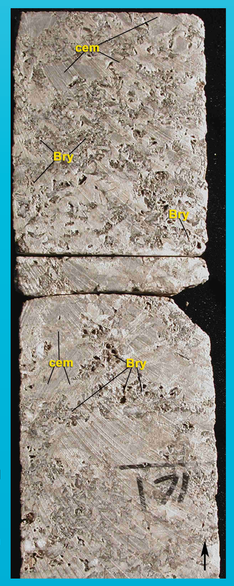
Limestones containing well-preserved, partially articulated crinoid stems and parts, as well as articulated thin-shelled bivalves (B) are typical of Open Marine deposits.

Bryozoan Mounds



◀ Mustang 3
(26 - 36S - 23E)
6150 ft.

A mesh-like network of tubular and sheet-type (fenestrate) bryozoans (Bry) provide the binding agent for this variety of lime mud-rich mound. Crinoids (C) and other open-marine fossils are common throughout these quiet-water buildups. Porosity is mostly confined to preserved intraparticle (WP) spaces (in black).

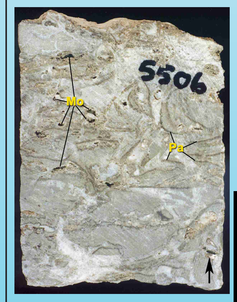


Mustang 3 ▶
(26 - 36S - 25E)
6171 ft.

Large tubular bryozoans (Bry) and "lumps" of marine cement (cem) dominate this mound fabric. Occasional phylloid-algal plates are also present. This mound fabric is typical of higher energy, and possibly shallower water than the mud-dominated fabric shown in the core to the left.

Scale: All core photos are approximately 1:1

Phylloid-Algal Mounds



◀ Tincup Mesa 3-26
(26 - 38S - 25E)
5506 ft.

Large phylloid-algal plates (PA) in near growth positions are surrounded by light gray lime muds. This baffestone fabric is typical of mound interiors. Note the scattered moldic pores (Mo) that appear black here.

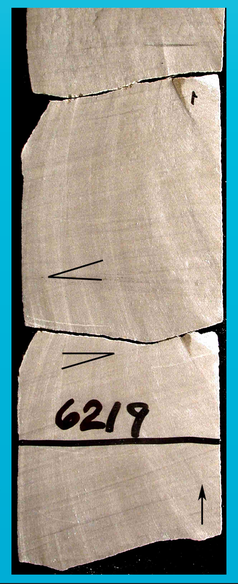
Bonito 41-6-85 ▶
(6 - 38S - 25E)
5590.5 ft.

Very large phylloid-algal plates (PA) and loose skeletal grains between the plates serve as substrates for substantial amounts of black marine botryoids (BC) as well as light brown, banded internal sediments and marine cements (WS/C). This phylloid-algal bindstone (cementstone) is typical of the well-cemented "walls" on the high-energy margins of productive algal mounds. Note the patches of preserved porosity within coarse skeletal sediments between algal plates.

Quartz Sandstone Dunes (?)

◀ Mustang 22-43
(26 - 36S - 23E)
6204 ft.

Very fine-grained, well-sorted quartzose sandstones that display moderate- to high-angle cross-bedding suggest the presence of sand dunes within a few areas of the study area. The well-rounded nature of the individual quartz sand grains (visible in thin sections) are consistent with a possible aeolian origin for these dunes.



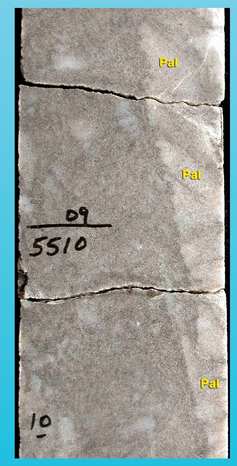
Mustang 22-43 ▶
(26 - 36S - 43E)
6219 ft.

The high-angle cross-stratification shown here is typical of the sedimentary structures within a 35 ft.-thick quartz sandstone dune(?) field encountered within this well in Mustang Flat oil field.

Anhydritic Salinas

▲ Tank Canyon 1-9
(9 - 37S - 24E)
5343 ft.

Nodular-mosaic ("chicken-wire") anhydrite is one of several growth forms seen within the locally thick accumulations of upper Ismay intra-shelf basins.



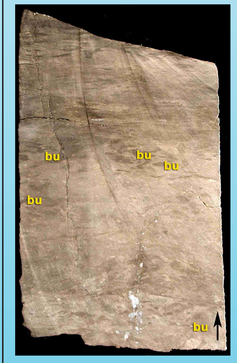
▲ Sioux Federal 30-1
(30 - 38S - 25E)
5510 ft.

Large palmate crystals of anhydrite (Pal) along the left hand margin of this core segment probably grew in a gypsum aggregate that resembled an inverted candelabra. The remainder of the core segment consists of detrital and chemical evaporites (anhydrite) that filled in the relief around the palmate structure. Palmate growth forms such as this example are probably indicative of subaqueous deposition.

▲ Montezuma 41-17-74
(17 - 37S - 24E)
5882 ft.

Thin, cm-scale, banded couplets of pure anhydrite (in white to light gray) and dolomitic anhydrite (in brown) are the products of very regular chemical changes in the evaporite intra-shelf basins. These varve-like couplets are probably indicative of relatively "deep-water" evaporite precipitation.

Middle Shelf



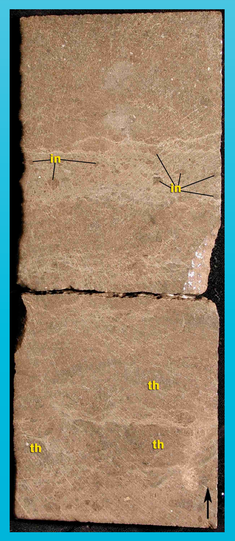
◀ Tank Canyon 1-9
(9 - 37S - 24E)
5412.5 ft.

Bioturbated lime to dolomitic mudstones are the most common depositional product of the Middle Shelf setting in the Upper Ismay. Compacted sub-horizontal feeding burrows (bu) are ubiquitous. Note the paucity of megafossils and visible matrix porosity.

Cuthair 1-28 ▶
(28 - 38S - 22E)
5758 ft.

Fusulinid-rich lime wackestones to packstones are also present in Upper Ismay Middle Shelf deposits. Fusulinids and crinoid parts are the predominant grains in this very tight, biogenically graded limestone.

Inner Shelf/Tidal Flat



◀ Tin Cup Mesa 2-23
(23 - 38S - 25E)
5460.5 ft.

Clotted, lumpy and poorly laminated microbial structures resembling small thrombolites (th) are common within dolomitized, restricted Inner Shelf/Tidal Flat settings. Intraclasts (in) composed of desiccated and redeposited thrombolitic fragments are common in some layers. Megafossils and visible porosity are very rare in this setting.

#5 Patterson ▶
(4 - 38S - 25E)
5443.5 ft.

Non-skeletal grainstones (calcarenites) composed of ooids, coated grains and "hard peloids" like this example occur as high-energy deposits in some Inner Shelf/Tidal Flat settings. Remnants of interparticle and moldic pores are present. The dark gray patches and columns are anhydrite-cemented sediments.

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