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Former Evaporites Within English Zechstein First Cycle Carbonates

The Upper Permian Cadeby Formation was deposited on the western margin of the Zechstein evaporite basin. The formation comprises two carbonate members which were nearly entirely dolomitized during early diagenesis. Recent meteoric dissolution in the shallow subsurface precludes the presence of evaporites within the carbonates at outcrop, but both direct and indirect evidence indicates the existence of former displacive and replacive evaporites.

Direct evidence of former evaporites is present in the form of both pseudomorphs and casts. In the lower member, textural preservation of internal fabrics within some anhydrite nodules was produced by calcitization of both anhydrite cleavage flakes and possible small chevron halite crystals. Where no replacement preceded dissolution, cauliflower-shaped molds 2 to 3 cm (.78 to 1.18 in.) in diameter evidence the former presence of anhydrite nodules in lower member lagoon wackestones and mudstones. Anhydrite nodule development distorted bedding laminae, indicating displacive growth within soft sediments. Halite hopper casts surround some former nodules. Lack of evidence of subaerial exposure or intertidal sedimentation suggests both sediment deposition and anhydrite nodule growth were subaqueous; evaporites forming when lagoon waters became restricted and progressively hypersaline.

Further direct evidence of interbedded evaporites is shown by fabrics of vertically oriented calcite crystals with scattered pseudomorphs of gypsum crystal margins. Ghosts of foraminifera, only visible under cathodoluminescence, and numerous dolomite inclusions are present within the calcite. The vertical orientation suggests relict gypsum precipitates on the sediment surface. These calcitized gypsum horizons are underlain by skeletal lime wackestones and packstones and overlain by irregular dolomite mudstones with casts of displacive gypsum rosettes, indicating subaqueous evaporite growth within sediment during periodic hypersaline conditions.

In the upper member, indirect evidence of former bedded evaporites overlying the Cadeby Formation is provided by an irregular bed of dedolomite (calcitized dolomite). The dedolomite transects facies boundaries, being found in supratidal carbonates with incipient tepee structures, intertidal and subtidal cryptalgal laminate boundstones, and ooid grainstone shoals. Dedolomite thickness varies from 0.5 to 2.5 m (1.5 to 8 ft) within individual outcrops. Dedolomitization was due to the action of fluids with high Ca^{2+}/Mg^{2+} ratios, created by dissolution of the overlying Hayton Evaporite Formation, with dedolomite thickness dependent on local differences in the permeability of the preexisting dolomites. Petrographically, these dedolomites contrast with ferroan dedolomites elsewhere in the Cadeby Formation and not spatially associated with evaporites.

The presence of former replacive evaporites is shown by irregular vugs which crosscut sedimentary laminations. Such vugs are more numerous in the upper member. Petrography indicates this replacement occurred before final compaction of the carbonates and was possibly related to diagenetic changes within the overlying anhydrite formation.

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Stratigraphy, Depositional History, and Reservoir Potential of Cretaceous and Early Tertiary Rocks of Lower Cook Inlet, Alaska

Depositional relations within strata of Cretaceous age in the lower Cook Inlet area have been clarified by recent drilling and high quality seismic data. Lower Cretaceous (Neocomian) strata are preserved along the Cook Inlet basin axis and are correlated with the Herendeen Formation of Port Moeller and the Nelchina beds in the Matanuska Valley. The Kaguyak Formation of Cape Douglas is expanded to include strata which range in age from Albian through Maestrichtian. Three members are proposed, which are (in ascending order) the Unnamed Albian-Cenomanian, the Middle Member, and the Saddle Mountain Member. Depositional relations within the Kaguyak Formation were strongly controlled by tectonic events and resultant basin configuration.

The Unnamed Albian-Cenomanian Member (up to 1,400 ft [425 m] thick) is composed of carbonaceous sandstone and shale. It is correlated with similar-age deposits in the Matanuska Valley and the Mt. Katmai area, and represents shallow to marginal marine deposition. The Middle Member is up to 4,400 ft (1,350 m) thick and consists of a southeastward-thickening wedge which is predominantly marine siltstone and claystone. Sandstone is significant only at Kaguyak Bay where proprietary studies indicate submarine fan deposition, and in the Socal Anchor Point well where a similar environment is likely. Middle Member strata lap-up on and over-top a topographic shelf, which began to develop at about Turonian time and was a prominent feature in the area east of the Iniskin Peninsula by Campanian time.

Significant shallowing at the beginning of Maestrichtian time was accompanied by an outpouring of coarse clastics of the Saddle Mountain Member. Up to 2,000 ft (600 m) of mostly nonmarine sandstone, siltstone, and conglomerate extends seaward (southeastward) to the shelf edge. We suggest that this shelf edge was the paleolimit of Saddle Mountain Member deposition and that marine reworking and washing fluvially supplied sand along this shelf edge provided the only Cretaceous sandstone with reservoir potential in this area.

Overlying and possibly continuous with the Saddle Mountain Member is a Paleocene sequence of sandstone and conglomerate, about 600 ft (185 m) thick in the COST well. This interval is seismically and lithologically distinct from the underlying Cretaceous and overlying West Foreland Formation rocks and is named the Silver Salmon Formation. This formation showed the best reservoir properties of the Tertiary rocks in lower Cook Inlet.

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Plate Tectonics Control of Global Patterns of Detrital and Carbonate Sedimentation

Global patterns of continental drainage to the oceans have changed markedly over the last 200 m.y. in response to plate tectonic processes; most of the earth's major rivers now enter the sea on passive continental margins which did not exist in the early Mesozoic. This reorganization of drainage has strongly influenced the distributions of marine detrital and carbonate facies.

Analysis of changes in continental topography related to the breakup of Pangaea suggest that throughout much of the Mesozoic, drainage systems were dominated by a pole-to-pole divide directing detrital sediment away from the sites of future continental rifting. This phase was followed by rifting and formation of narrow oceans with uplifted margins. As the margins subsided by thermal relaxation, massive amounts of detrital sediment