5. MOAB VALLEY

LOCATION

The Moab Valley is an elongated valley that runs in a northwest to southeast direction in eastern Utah. It is located mainly to the south of the town of Moab and can easily be seen as high cliffs on either side as one drives along U.S. Highway 191 through the Moab region.

DESCRIPTION

The Moab Valley (Fig. 1) is one of six to eight (depending on subdivision) elongated parallel valleys that run in a northwest-southeast direction in western Colorado and eastern Utah. These valleys are all anticlines (layers convex upward) whose central portions subsided and have been eroded, leaving valleys between opposing cliffs (Baars and Doelling 1987, Chenoweth 1987). These anticlines were formed by the migration of salt (also called an *evaporite*) to the region below the valleys, mainly along fault lines. Upward migration of the salt caused uplift of the valley regions prior to erosion. The salt, which has a lower density than the surrounding rock, migrated up below the developing valleys along zones of least confining pressure.

FIGURE 1. View from the south end of the Moab Valley looking north. The valley was formed by the migration of salt, faulting, and by erosion. The gray Cedar Mountain-Burrow Canyon (Cretaceous) layers in the center and right foreground (red arrow) of the valley used to be much higher above the level of the reddish to tan layers (Jurassic Triassic) forming the sides of the valley. These Cretaceous gray layers, which are stratigraphically higher than the reddish-tan layers, collapsed down due to dissolving of the salt below the floor of the valley and other factors including possible lateral expansion (rifting) inducing collapse.

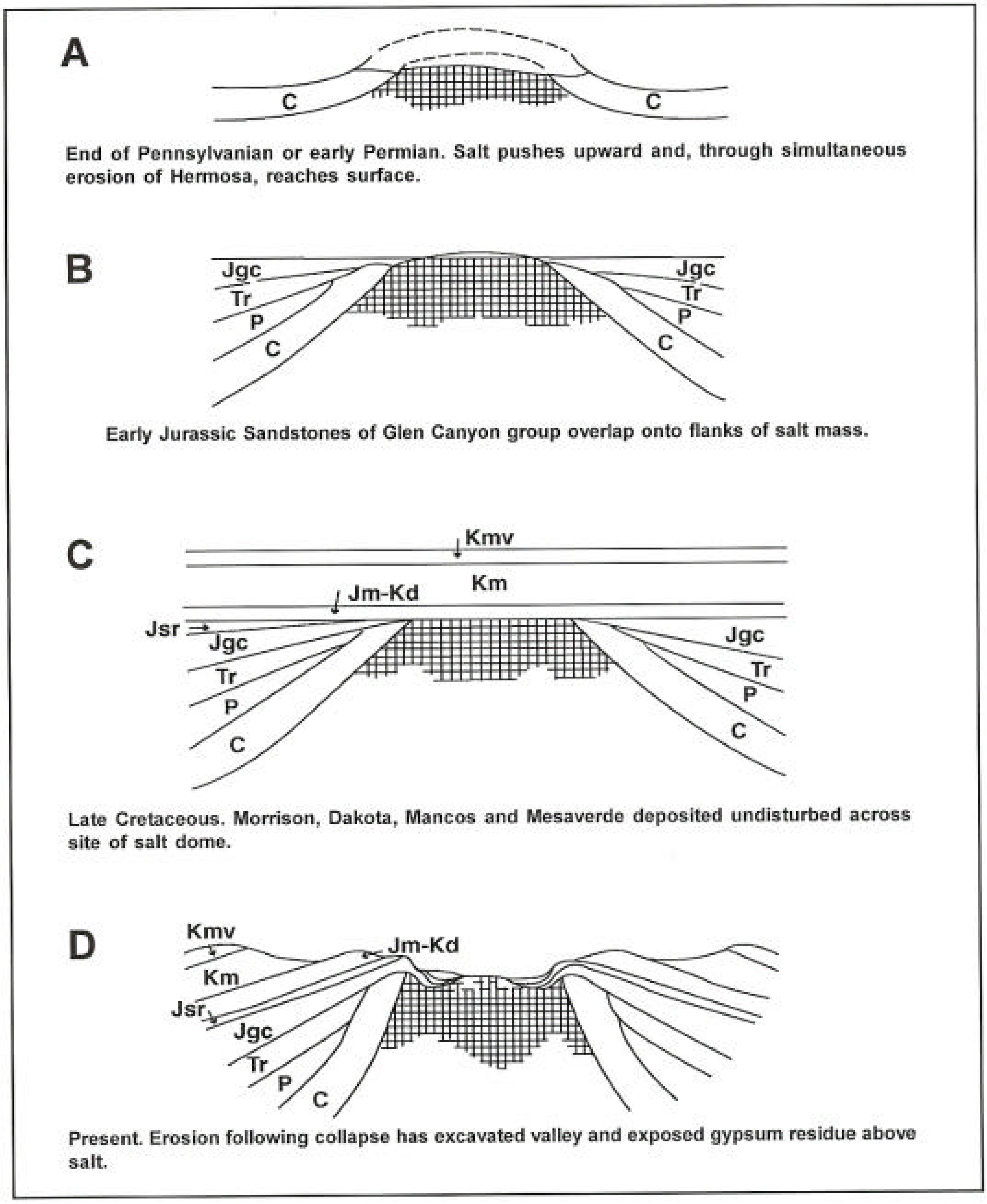

FIGURE 2. Postulated sequence in the formation of salt valleys. Hatched pattern -- salt; C – Carboniferous (Pennsylvanian); P – Permian; Tr – Triassic; Jgc – Jurassic Glen Canyon Group; Jsr– Jurassic San Rafael Group; Jm-Kd – Jurassic-Cretaceous Morrison to Dakota; Km – Cretaceous Mancos Shale; Kmv – Cretaceous Mesa Verda Group. Modified from Thornbury (1965) p. 432.

Movement of the salt occurred mainly from Pennsylvanian through Triassic time (Figure 2). A little more salt migration may have occurred during the Laramide Orogeny late Cretaceous and early Tertiary time. As the valley regions moved up, it appears that deposition of surrounding formations was restricted over the rising ridges, but this is a disputed point. In the late Cretaceous the Mancos Shale completely covered the region (Fig. 2 C). This was followed by further accentuation of the anticlines by west-to-east compressional pressure, but some also argue for extension (Ge 1996). Solution of the salt caused collapse of the valley floor, and occasionally the Burrow Canyon can be seen much lower (Fig. 1) than the stratigraphically lower valley walls. Erosion of sediments in the central part of the valley accentuated the topography. The Moab Fault on the southwest side of the valley is an apparently normal fault, suggesting expansion of the valley, with a down drop of as much as 2600 feet of the northeast side.

The Paradox salt layer, that migrated up and eventually caused the valleys to form, is not pure and contains significant clay, gypsum, and limestone. It is from 2,000 to 6,000 feet thick in the surrounding region, but reaches up to 12,000 feet under the Moab Valley and 15,000 feet under the Paradox Valley to the east. There is no salt exposed on the floor of the Moab Valley but there are associated gypsum outcrops along the southwest side of the valley.

Up to 29 cycles of evaporation have been proposed for the Paradox salts. It would require the evaporation of many kilometers of depth of sea water to produce one cycle; hence a reflux model with repeated addition of sea water in a barred basin is proposed. It would require many reflux cycles of replacement to produce one of the 29 cycles of the Paradox salts. The sequence of precipitation of various salts from sea water is sometimes normal and sometimes reversed, and various reflux systems have been proposed to accommodate this (Hite 1973).

One of the baffling features of the region is that major rivers cut almost perpendicularly across the long valleys. The Colorado River cuts across the Fisher and Moab Valleys, and the Dolores River cuts across the Paradox Valley. Another question is why are the centers of these elongated anticlines cleaned out while the sides remain? The paradox of rivers flowing perpendicularly to the valleys is the reason for the names: Paradox Valley, the Paradox Formation, which is the source of the salt, and the Paradox sedimentary basin of the region. Several explanations have been proposed and will be considered later in connection with erosion of the Uinta Mountains. This paradox is also seen in the Grand Canyon region.

A CREATION-FLOOD PERSPECTIVE

The traditional view that the salt of the Paradox Formation formed as a result of the evaporation of sea water does not fit easily with the concept of the deposition of most of the Phanerozoic sediments in a one year flood. On the other hand, one can postulate “original” preflood salt deposits getting involved in these sediments, as the crust of the Earth broke up at the time of the flood. Uplift and erosion of the salt valleys would take place during and after the flood.

The traditional slow evaporation model for the formation of salt is not without serious problems. It would take a thickness of around 25 miles of sea water to produce 2000 feet of Paradox salt. And when you evaporate sea water calcium and gypsum precipitate out first. Repeatedly replenishing an evaporation basin with sea water by a reflux-barrier system is the usual long-age explanation, but requires special fortuitous conditions for a very long time. Because of many difficulties a number of other models for the formation of evaporite salts have been proposed such as volcanic activity (e.g. Rode 1944).

The very few natural salt deposits now being formed by evaporation on our Earth are extremely minute compared to the huge salt deposits found in the sedimentary record of the past. Past conditions seem definitely different from present ones. There are no thick evaporites forming anywhere on earth today!

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