

MIDDLE DEVONIAN TO LATE MISSISSIPPIAN EVENT STRATIGRAPHY OF OVERTHRUST BELT REGION, WESTERN UNITED STATES

by

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ABSTRACT. - Twenty eustatic and epeirogenic events mainly dated by conodonts are distinguished between the Middle Devonian and the lower Upper Mississippian in Great Basin, in Rocky Mountains and in the Overthrust belt regions. (Abstracted by the editors).

RESUME. - Vingt phénomènes eustatiques et épeirogéniques datés principalement par conodontes du Dévonien moyen au début du Mississippien supérieur dans les régions du Grand Bassin, des Montagnes Rocheuses et dans la ceinture charriée, sont résumés et discutés brièvement.

The region of the Overthrust belt from Montana to Nevada was the depositional site for continental-shelf and peritidal upper Middle Devonian and Upper Devonian carbonate rocks and platform, foreslope, and foreland-trough Lower Mississippian to lower Upper Mississippian carbonate rocks. Devonian rocks include many beds of porous dolomite that could serve as petroleum reservoirs. Mississippian rocks contain source, conduit, and reservoir beds. The present position of the late Early Mississippian shelfedge corresponds closely to that of the leading edge of the late Mesozoic Sevier thrust system, and the abrupt changes in thickness, bedding, and competence of Mississippian rocks at this shelfedge may have been a factor in determining the position of later thrusting. The leading edge of the Sevier system also is subparallel to and about 125-400 km east of the present position of the Mississippian Antler orogenic highlands.

The Middle Devonian (late Givetian) to Late Mississippian (middle Meramecian) history of the Overthrust belt region comprises two major transgressive-regressive marine cycles or depophases. The history has been interpreted using a series of thickness, lithofacies, and paleogeographic maps (Sandberg and others, 1983). The intervals or horizons for which these maps were constructed are dated mainly by a conodont zonation that includes 28 high-resolution Late Devonian conodont zones (all but one having a timespan of ~0.5 m.y.) and 10 moderate-resolution Mississippian zones (each having a timespan of ~1.5 or ~3 m.y.). Brachiopods provide a supplemental Devonian zonation. Corals and calcareous Foraminifera provide supplemental Mississippian zonations.

The following table of 20 eustatic and epeirogenic events is timed by the conodont zonations in millions of years (m.y.) before (-) or after (+) the time of the Devonian-Carboniferous boundary (DCB). The Middle to Late Devonian depophase comprises a sequence of 14 events (events 1-14) that lasted ~21.5 m.y. The Early to Late Mississippian partial depophase comprises a sequence of 6 events (events 15-20) that lasted ~19.5 m.y. Events 13 and 14 represent an episode of continental stability that previously (Sandberg *et al.*, 1983) had not been assigned to either depophase. In the table, the standard conodont zonal dating is given for significant eustatic events.

EUSTATIC AND EPEIROGENIC EVENTS

	D.C.B.
	~m.y.
20. Major lowering of sea level; karst develops on carbonate platform (<i>Cavusgnathus</i> Zone)	+ 24
19. Major rise in sea level; marine onlap of entire North American craton; deepening of Deseret starved basin (<i>anchoralis-latus</i> Zone)	+ 12

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18. Start of Deseret starved basin; formation of foreslope around carbonate platform	+ 10.5
17. Formation of clinoform ramp bordering carbonate platform	+ 9
16. Formation of widespread carbonate platform; westward shedding of calcareous flysch from epeirogenic uplifts	+ 6
15. Major rise in sea level; onlap of entire North American craton (Lower <i>crenulata</i> Zone)	+ 4.5
14. Formation of narrow seaway from Nevada to southern Montana	+ 3
13. Start of minor transgression during episode of continental stability (<i>sulcata</i> Zone)	0
12. Start of major regression (Middle <i>praesulcata</i> Zone)	- 0.5
11. Rise in sea level; significant onlap of craton (Lower <i>expansa</i> Zone)	- 2.5
10. Regression; onset of epeirogenic uplifts (e.g., Central Montana, Southern Beaverhead Mountains, and Sevier uplifts) and of erosion in most of western United States	- 3.5
9. Minor onlap; formation of narrow epicontinental seaway from western Canada southward to southern Nevada and eastward to southern Arizona (Lower <i>trachytera</i> Zone)	- 4.5
8. Major regression; end of carbonate-platform sedimentation in Idaho, Utah, and Nevada; spreading of sabkhas; onset of continentwide erosion	- 5
7. Expansion of Pilot basin (Lower <i>marginifera</i> Zone)	- 6
6. Rapid subsidence of Pilot basin	- 9
5. End of record of carbonate-platform sedimentation in Montana and Wyoming (Lower <i>gigas</i> Zone)	- 10
4. Formation of Pilot basin in Nevada and Utah	- 12.5
3. Formation of widespread carbonate platform in western United States	- 13
2. Marine embayments drown former valleys from Arizona to southern Canada	- 13.5
1. Major rise in sea level; start of Taghanic onlap of entire North American craton (Middle <i>varcus</i> Subzone)	- 17

The updated major findings of our study, which was presented in its entirety by Sandberg and others (1983), are summarized below:

1. The geologic history of the Middle Devonian to lower Upper Mississippian rocks of the Great Basin, Rocky Mountain, and Overthrust belt regions can be interpreted in terms of two eustatic (transgressive-regressive marine) cycles or depophases.

2. The eustatic changes and the epeirogenic and orogenic events that influenced them can be dated in millions of years before or after the time of the Devonian-Carboniferous boundary by means of a biostratigraphic time scale that is based on conodont zones.

3. The biostratigraphic position of the Australian volcanic sample that produced the radiometric date conventionally used for the Devonian-Carboniferous boundary or the Frasnian-Famennian boundary is highly questionable in terms of the standard Late Devonian conodont zonation.

4. The age of the top of the type Jefferson Formation in Montana is dated as Frasnian (event 5) by the discovery of conodonts of the Lower *gigas* Zone in its upper, Birdbear Member. Consequently, the so-called Birdbear Member in Idaho, which is Famennian (Lower and Upper *marginifera* Zones) in age, is not correlative. The change between the two Upper Devonian sequences takes place across the Southern Beaverhead Mountains uplift, just behind the leading edge of the Sevier thrust system.

5. An episode of widespread epeirogenic uplifts (event 10), including the Southern Beaverhead Mountains, Central Montana, Uinta, and Sevier uplifts, took place in Late Devonian time in a ~1 m.y. interval beginning at DCB - ~3.5. m.y.

6. The major transgression that took place during the timespan of the Lower *crenulata* Zone (event 15) moved at the remarkably rapid rate of ~20-40 cm/year or roughly 0.3-0.6 mm/high tide.

7. A carbonate-platform sequence, comprising the Woodhurst Member of the Lodgepole Limestone and the Mission Canyon Limestone, is present on the protuberance of the Sevier thrust system in northern Utah. If this system moved rocks a considerable distance relatively eastward, as is generally accepted, a lobe of the Mississippian carbonate platform must have extended westward in that area.

8. The Mission Canyon Limestone and Aspen Range Formation are present in the Blackfoot Mountains, Bingham County, Idaho. This finding extends the area of possible stratigraphic traps in the Mission Canyon northward from the Aspen Range to the south edge of the Snake River plain.

9. Prodeltaic sediments that filled the former Deseret starved basin (event 20) did not come uniformly from the east and west. In the southern part of the basin, they were mainly western-derived and came from a series of deltas that were fed by Antler molasse. In the northern part of the basin, the prodeltaic sediments were mainly eastern-derived and originated in the Humbug deltaic complex.

10. A delta lobe extended northward from the Humbug deltaic complex. It includes beds formerly called Wells (?) Formation in the Crawford Mountains and the sandstone member of the Little Flat Formation at Old Laketown Canyon.

11. Evidence of the partial destruction of the Late Mississippian carbonate platform (event 20) is provided

by conglomerates containing shallow-water carbonate clasts in the Uncle Joe Member of the Deseret Limestone at Elephant Canyon, Utah.

12. The late Mesozoic Sevier thrust system is close and subparallel to the late Early Mississippian shelf-edge. Changes in facies and competence of Mississippian rocks near this shelf-edge may have helped control the location of later thrusting.

13. Knowledge of the geologic history of Middle Devonian to Upper Mississippian rocks of the Utah hingeline and Overthrust belt and adjacent regions

is an aid to identifying source rocks and conduit beds and locating petroleum reservoirs.

REFERENCE

- SANDBERG, C.A., GUTSCHICK, R.C., JOHNSON, J.G., POOLE, F.G. & SANDO, W.J., 1983. Middle Devonian to Late Mississippian geologic history of the Overthrust belt region, western United States : Denver, Colorado, Rocky Mountain Association of Geologists, Geologic Studies of Cordilleran Thrust Belt, 2 : 691-719, 17 figs. (Date of imprint, 1982).