poraneous Austin-type sediments were accumulating upon an offshore bench or line of prominences. It is inferred that lowermost Austin sediments were deposited upon an offshore, relatively shallow and high-energy floor of likely high temperature and chlorinity.

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POTTSVILLE CONGLOMERATES IN PENNSYLVANIA: PALEOCURRENTS AND ORIGIN

During Pottsvillean time, two major and strikingly different conglomerates were deposited in the northern part of the Central Appalachians. These are the Pottsville formation which crops out in the anthracite area and the Olean (Sharon) conglomerate which occurs along the northern escarpment of the Allegheny Plateau. The Olean (Sharon) is equivalent stratigraphically to only part of the thicker Pottsville formation.

An integrated stratigraphic, petrologic, and paleocurrent study was made of these conglomerates to reconstruct the clastic dispersal system, the geometry of the basin, and the conditions of deposition. Isopach, lithofacies, cross-bedding, maximum pebble size, and petrographic data were used to attain these objectives.

The depositional basin—an asymmetric, elongate trough which trends northeast-southwest—consists of (1) a narrow zone of maximum subsidence (trough) along its southeastern margin, and (2) a broad stable shelf area at the northwest. The basin was bounded on the southeast by a tectonic source land composed dominantly of metamorphic and sedimentary rocks and on the north by a stable cratonic area consisting largely of sedimentary and low-grade metamorphic rocks. Both areas contributed coarse gravels to the depositional basin.

A thick (up to 1,300 feet) wedge-shape conglomeratic sequence (Pottsville formation) was deposited along the southeastern margin of the basin by alluvial fans emerging from the southeastern highland. Initially, deposition was restricted to the trough area, where deposition was uninterrupted from the Mississippian to the Pennsylvanian, but later spread to the shelf. The transport direction was northwest (300–360°), transverse to the axis of the basin and down the paleoslope. The depositional strike paralleled the axis of the basin. The stratigraphic section thins downslope from the fall line, located near Philadelphia. This "tectonic" dispersal system deposited orthoquartzitic conglomerates and lithic sandstones (protoquartzites).

The thin (generally less than 50 feet) sheet-like conglomerate deposit (Olean-Sharon) along the stable northern margin of the basin was deposited by two contemporaneous fluvial systems, one located in north-central Pennsylvania, which dispersed material toward the southwest, and one in northeastern Ohio, which dispersed material toward the south. These systems transported material obliquely and parallel with the axis of the basin across an erosional Mississippian surface. These orthoquartzitic conglomerates and sandstones were deposited by the "cratonic" dispersal system.

In the central part of the basin, three sheet-like fluvial sand bodies (protoquartzite and orthoquartzite) were deposited. The lower Connoquenessing sandstone was deposited by the "cratonic" system; this sandstone and the Olean conglomerate appear to be part of the same rock stratigraphic unit. The upper Connoquenessing and Homewood sandstones were deposited by the "tectonic" system.

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APPLICATION OF DIAGENETIC PRINCIPLES TO PETROLEUM EXPLORATION

Investigations directed toward petroleum exploration problems have shown that diagenetic parameters can be useful in mapping subtle structural features that are not otherwise apparent. The investigations are based on the premise that structural movement alters the primary character of a sediment and that the degree and extent of alteration are a function of: (1) type of movement, (2) local intensity of stress, (3) age of movement with respect to reference horizons, and (4) the number of movements. Emphasis for exploration purposes is placed on (a) analysis of the alteration within the objective or reservoir horizon, and (b) interpretation of the structural history of the objective horizon in terms of stratigraphy, textural distribution patterns, and alteration in the overlying strata.

At numerous locations in the northern Rocky Mountains, anomalous textural distribution patterns in strata of different ages are superimposed on each other. These patterns reflect the recurring influence of structural movement in the same place at different periods in geologic time. Having defined these trends in broad terms of sedimentation, the local structural anomalies can be defined more precisely by analyzing the diagenetic changes; i.e., changes in cementation, grain and crystal alteration, solution characteristics, and fracture filling. These parameters show by the stratigraphic position of the alteration the influence of compaction, downwarp, upwarp, flexing, folding, incipient faulting, and truncation.

Calcite to dolomite conversions, as mineral cement in detrital rocks or as host material, offer the most apparent type of change as an indicator of structural deformation. Examples in the Williston basin are shown from Nesson and Cedar Creek anticlines, and also from the projection of the down-warped flexure related to the Van Norman fault. Other local areas along the northern limb of the basin are presented for appraisal.

Recrystallized and injected forms of anhydrite and halite are used as supplemental criteria because of their instability under stress. As deterrents to permeability, they receive special consideration when encountered in the objective horizon. Examples are cited from the Nesson-Frobisher and Midale facies in the northern Williston basin and from the Minnelusa formation of Wyoming.

Authigenic chert and quartz mosaics in the host rock and in fractures are used to help define faulted zones and unconformable contacts related to uplift and erosion. Examples are cited from the post-Mississippian–pre-Triassic surface of central Montana.

Results of these and other investigations show that alteration criteria can help to localize exploration prospects, and that some of the better known "stratigraphic traps" in the northern Rocky Mountains have had a recurring history of structural advantage over the surrounding area throughout much of geologic time.

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ASPECTS OF REEF DEVELOPMENT AS ILLUSTRATED BY THE DEVONIAN ANCIENT WALL REEF COMPLEX, ALBERTA*

The Ancient Wall reef complex occurs in thrust sheets of the western Front Ranges of the Alberta Rocky Mountains north of Jasper. The reef complex is exposed

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