PETROLOGY AND DIAGENESIS
OF THE LOWER SILURIAN TUSCARORA SANDSTONE,
KANAWHA COUNTY, WEST VIRGINIA

THESIS

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ABSTRACT

In west-central West Virginia, the Lower Silurian Tuscarora Sandstone is a fine-grained to conglomeratic quartz arenite. It is of particular interest because of its production of gas which is commonly rich in CO_2. This present study is mainly concerned with the diagenetic processes and porosity development of the Tuscarora based on a core from the David Ward well No. 64 (Kan. 2751) in Kanawha County. In this area the Tuscarora is approximately 90 feet (27.5 m.) thick, of which the lower 51 feet (15.5 m.) were cored.

Many environments of deposition have previously been proposed for the Tuscarora. Based on sedimentary structures, grain size variations, and trace fossils contained in the core, the Tuscarora appears to have been deposited as a coastal sand in an environment characterized by high energy, shallow water, and high sedimentation rates.

The chief cement in the Tuscarora is secondary quartz, and this is the main cause of porosity reduction. Secondary quartz occurs as anhedral to euhedral overgrowths, conformal overgrowths, and meniscus cement. Pressure solution is also an important factor in reducing porosity, and is particularly enchanced by the presence of illite as grain coatings or along laminae.

Differential cementation of the Tuscarora is apparently widespread. It appears to be as

well-developed in Kanawha County as in the outcrop belt in eastern West Virginia. Variations in cementation along and across beds produce a lattice network around porous zones, and also produce sharp contacts between uncemented and tightly cemented layers. In some areas, differential cementation leaves a cup or cone of porsity between grains directly above large quartz grains and clay clasts.

Porosity overall, and particularly in the differentially cemented areas, appears to be primary in origin as a result of incomplete cementation, and is related to the presence of clays. Clays, particularly illite, have prevented the nucleation of quartz and thereby preserved porosity. Dewatering of sediments, burrowing, and the presence of gas bubbles have been proposed as possible mechanisms controlling the distribution of clay. Porosity is also related to grain size and shows an increase with grains larger than fine sand.

Dissolution os soluble minerals, such as feldspar, is responsible for minor amounts of secondary porosity in the Tuscarora. Other changes in the rock include replacement of quartz, possible clay alteration, and the precipitation of carbonate and sulfate cements.

(Bruner, 1983)

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CONCLUSIONS

The Tuscarora Sandstone, a Lower Silurian orthoquartzite, is of particular interest in Kanawha County, West Virginia because of its production of gas which is commonly rich in CO_2. Porosity in the Tuscarora, as studied in a 51 ft. core recovered from the David Ward Well No. 64, appears to be primary in origin as a result of incomplete cementation. Cementation has been adversely affected by the presence of clays which coat the quartz grains and inhibit the development of secondary overgrowths. Porosity is also related to grain size in the Tuscarora, and drastically increases with grain sizes larger than fine sand. Porosity is best developed in the lower and central portions of the core where grain size is medium to pebbly and clays coat the grains.

Secondary quartz is the primary cement in the Tuscarora and is responsible for almost total elimination of porosity in the fine-grained sandstones. Secondary quartz has also replaced much of the feldspar, which was originally present in the rock.

Small amounts of secondary porosity has developed in the fine-grained sandstones in the form of moldic and intraconstituent porosity. This porosity formed from the dissolution of unstable or soluble minerals such as feldspar.

Differential cementation, a particular characteristic of the Tuscarora, is as widespread in the subsurface as in the outcrop belt. All types of this cementation are developed in core. Sharp boundaries between cemented and porous areas, and distinct geometries of the porous and cemented areas are features of differential cementation. Grains in the porous areas are clay-coated, while grains in the cemented areas are clay-free. The clays inhibit quartz overgrowths, and the distribution of clays may have been controlled by the dewatering of sediments, burrowing, or the presence of gas pockets or the degassing of sediments.

Fluvial and marine environments have been proposed for deposition of the Tuscarora. Based on sedimentary structures and sequences, grain size variations, and the distribution and frequency of burrows, the Tuscarora appears to have been deposited as a coastal sand in an environment characterized by high and fluctuating energy levels, shallow water, and high sedimentation rates.