RECONSTRUCTING PALEOCURRENT DIRECTION IN THE CHADAKOIN AND GIRARD FORMATIONS IN NORTHWESTERN PENNSYLVANIA

MCCOY, Curtis*, Nicholas Kelly, and Lyman Persico
Meyerscough University, 501 East 38th St, Erie, PA 16546
tmccoy78@gmail.com

ABSTRACT

Extensive exposures of late Devonian Chadakoin and Girard Formations (Conemaugh Group) are exposed in Fourmile, Samielle, Twenty Mile, and Walnut Creeks, Erie County, Pennsylvania. Both formations consist of medium-gray shale interbedded with 5–25 cm thick silty shales. The Middle Devonian paleo-environment of these formations allowed for the creation and preservation of ripple marks in the fine sand and silt layers. Ripple crests are transverse inshore in phase and out of phase. Average grain size of ripple mark sediment was 0.03 cm. Ripple heights range from 0.3–5.2 cm (avg=0.05 cm) and wave lengths from 6–31 cm (avg=12.84 cm) (std=0.05 cm). Ripple sets were documented throughout Fourmile, Samielle, Twenty Mile, and Walnut Creeks and mapped stratigraphically to reconstruct paleocurrent directions and changes in time. Paleocurrent directions and changes in time were identified using rose diagrams and stratigraphy. During the transition from the Girard Formation to the Chadakoin Formation, asymmetrical ripple crests record a shift in current direction from the northeast to the northwest to trend in flow direction at N70°E and NW70°W. The shift in paleocurrent direction is hypothesized to be due to a change in dominant current forces of deep water bottom currents flowing parallel to the continental margin of the Catskill Sea (N–NE) to basinal turbidite flows transitioning from the Girard Shale to the Chadakoin Formation is one hypothesis explaining the observed changes in ripple current direction. Future work will consist of mapping ripple marks throughout all of Northwestern Pennsylvania along with using techniques developed by Dier (1995), Brenn (2005), and Ocola et al. (2012) to reconstruct paleocurrent direction and depth based on ripple height, ripple spacing, and grain size.

METHODS

Ripple marks were located in shale deposits incised and exposed by Twenty Mile, Six Mile, Fourmile, Walnut, and Elk Creeks, in Erie County, PA (Figure 1). Locations were collected using a survey grade Trimble GPS and recorded on 10x10 cm photographic prints. Average measurements of ripple spacing, height, symmetry, morphol ogy, strike, dip, and orientation were recorded for each ripple set (Table 1) and recorded in stratigraphic (Figure 1) samples were taken from four locations for thin sections to determine average grain size. Paleocurrent direction based on ripple mark orientation was plotted on a set of rose plots (Figure 3). All data was entered into an Excel database for analysis and compared to previous studies.

RESULTS

Assymetrical ripple marks exposed in Erie County PA show a mean flow direction of NW80°W. Flow direction fluctuates between SW70°E–NW70°W through time. Ripple crests range 2–4 cm with dissimilar particle size. The majority of ripple marks are asymmetrical and range 0.2–4.5 cm tall (Table 1), indicating weak currents for their formation. No fossils are found in deposits containing ripple marks but are found above and below these strata along with increased grain size. Ripple spacing ranges between 6–31 cm (Table 1). Ripple flow directions match at the same elevations between separate creeks, indicating lat et lying strata along with increased grain size. Ripple spacing ranges between 6–31 cm (Table 1). Ripple flow directions match at the same elevations between separate creeks, indicating lat et lying strata along with increased grain size. Ripple spacing ranges between 6–31 cm (Table 1). Ripple flow directions match at the same elevations between separate creeks, indicating lat et lying strata along with increased grain size.

DEBATE

Asymmetrical ripple marks exposed in Erie County PA show a mean flow direction of NW80°W. Flow direction fluctuates between SW70°E–NW70°W through time. Ripple crests range 2–4 cm with dissimilar particle size. The majority of ripple marks are asymmetrical and range 0.2–4.5 cm tall (Table 1), indicating weak currents for their formation. No fossils are found in deposits containing ripple marks but are found above and below these strata along with increased grain size. Ripple spacing ranges between 6–31 cm (Table 1). Ripple flow directions match at the same elevations between separate creeks, indicating flat lying bedrock of the Girard and Chadakoin formations. Due to a permanently NW flow direction, it is postulated that ripple marks treanding northwest are likely formed during low-density basin edge turbulence currents.

REFERENCES CITED