

2013 GSA Annual Meeting in Denver: 125th Anniversary of GSA (27-30 October 2013)

**Paper No. 247-52**

**Presentation Time:** 9:00 AM-6:30 PM

**A TEST OF THE ANALYTICAL WELLMAN AND MEAN POLYGON  
MOMENT ELLIPSE METHODS OF STRAIN ANALYSIS USING A SAMPLE  
OF DEFORMED ORDOVICIAN GRAPTOLIFEROUS SLATE FROM THE  
TACONIC OROGEN, NEW YORK**

[DIRRINGER, Sebastian](#), Geology Department, SUNY New Paltz, 1 Hawk Drive, New Paltz, NY 12561, sdurring@kent.edu and VOLLMER, Frederick W., Geology Department, SUNY New Paltz, New Paltz, NY 12561

An analytical solution to the Wellman method for the determination of strain from multiple angles of shear was given by Vollmer 2011, and implemented in the computer program EllipseFit 2. The method has been tested on synthetic brachiopod populations, but not on natural samples. A sample of slate with deformed Ordovician graptolites from the Taconic orogen, New York, in the SUNY New Paltz paleontology collection, was selected for a such a test. The sample allows a comparison with the mean polygon moment ellipse method, proven valid by Mulchrone and Choudhury 2004, and also implemented in EllipseFit 2. The method uses the vertices of polygons to calculate an ellipse with the same moments. A mean ellipse is then calculated using three methods: eigenvector, mean radial length, and hyperbolic mean. Four graptolite species were identified in the sample, including whole specimens and fragments. The sample was oriented with the slaty cleavage as the X axis. The center lines and lower thecae lines were digitized in 120 locations for the Wellman test, only one species had clearly defined thecae lines. The outlines of 31 whole graptolites and 38 partial graptolites were digitized for the polygon method test. The mean polygon method ellipse was  $R = 2.079 \pm 0.122$ ,  $\Phi = 177.48^\circ \pm 4.57^\circ$ , parallel to the slaty cleavage. The polygon method does not require assumptions about initial shapes, only that they are initially random. Interpreting the data for the analytical Wellman method was problematic, as it had large wings of outliers around a central ellipse. Removal of 77 outliers was required before the ellipse could be clearly resolved. While most outliers could be clearly identified, the process was subjective, and single outliers significantly effected the result. The result for 43 data points was  $R = 2.761$ ,  $\Phi = 0.50^\circ$ ,  $RMS = 0.294$ , parallel to cleavage. The outliers are believed to be due to initial variations in thecae angle, possibly more than one similar species or subspecies are present. We conclude that the necessary assumptions about initial geometry for the analytical Wellman method are not met, and that these assumptions limit the available sample size, making it difficult to use on this sample. The polygon method, with no such required assumptions about initial geometry, is preferred in this case.

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[General Information for this Meeting](#)

Session No. 247--Booth# 280

[Sigma Gamma Epsilon Undergraduate Research \(Posters\)](#)

Colorado Convention Center: Hall D

9:00 AM-6:30 PM, Tuesday, 29 October 2013

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