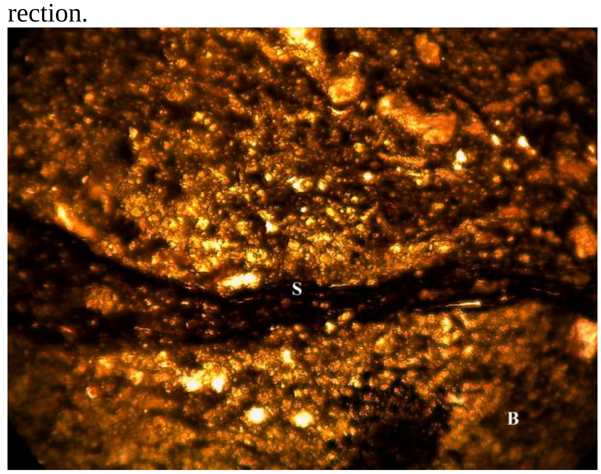
EVIDENCE FOR AN IMPACT ORIGIN OF JEPTHA KNOB USING CALCITE TWIN ANALYSIS AND METEORITE IMPACT AS A CAUSE OF DOLOMITIZATION. A. Schedl[1], L. Mundy[1.] and M. Buchner[1] (Dept. Physics, West Virginia State University, Institute, WV 25112 USA, schedlad@wvstateu.edu).

Introduction: In a previous presentation [1] we argued that the Upper Ordovician age feature, Jeptha Knob, was of impact origin. Our arguments were problematic, so we have sought further evidence of impact origin. Jeptha Knob is associated with massive dolomitization: two cores 300 to 400 m in length are almost entirely composed of dolomite except for a 30 m interval in one of the cores JK78-1. There is an elliptical .8 to 1.2 mGal, positive gravity anomaly, 2.2 km X 1.2 km, centered on Jeptha Knob, which is explained by dolomite being denser than the surrounding sediments [2]. The geochemistry of the dolomites is atypical: 1) Fluid inclusions and oxygen isotopes indicate hydrothermal fluids which are mixtures of seawater and basinal brines. An impact into an epeiric sea would produce hot waters which are a mixture of seawater and basinal waters. 2) Many of the dolomites have $^{87}Sr/^{86}Sr$ ratios >0.709, more radiogenic than any Paleozoic seawater. The radiogenic nature of the strontium isotopes indicates that the dolomitizing waters interacted with basement or the clastic rocks just above the nonconformity [1]. Basement is presently ≈1.5 km below the surface at Jeptha Knob, so fracturing due to impact could hydraulically connect rocks near the surface with basement. For this scenario to be true, one must have strong evidence of impact origin.

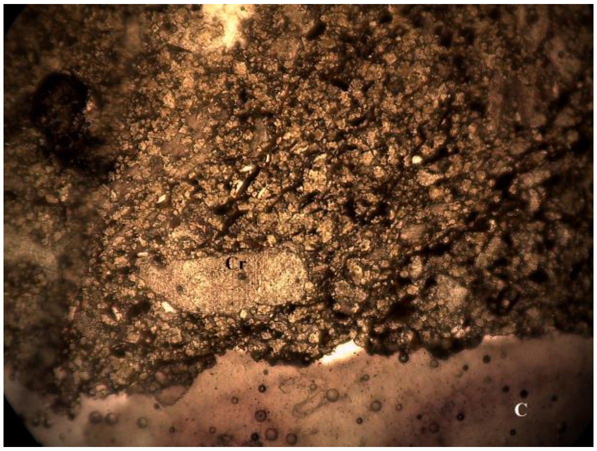
Methods: Two methods were used to evaluate impact origin: Jamison and Spang's [3] paleostress-piezometer for calcite and Groshong's [4] calcite-strain-gauge. For the calcite paleostress-piezometer the number of calcite grains with 0, 1, 2 and 3 twin sets were point counted, (200 to 1000 grains/slide). The slides were polished and then stained for calcite. Calcite was distinguished from dolomite by being stained, being more etched by acid, or having twins. Dolomite often occurred as rhombs. From the percent of grains with 1, 2, and 3 twin sets differential stresses were estimated [3]. Samples were taken from within and outside Jeptha Knob. For the calcite-strain-gauge the orientations of c-axes and e-poles of twins are measured using a U-stage. The number of twins in a particular twin set was counted and the width of the grain was measured perpendicular to the twin set. The data were input into a computer program to estimate the amount and directions of strain and Turner compression axes [4]. This technique was applied to sample JK78-1-8 (JK1-8), since the orientation of the sample can determined from facing indicators within the thin section.

Results: The KSG provided us with only small chips for thin sections, so it is difficult to know the exact orientation of bedding. Sample JK1-8 has alignment of features that suggest that bedding was oriented at a 30° angle to the long edge of the slide. We will assume that the slide is a vertical slice oriented approximately parallel to the dip direction of the bed and see if this is consistent with observations. All images that follow are at 5X, so the long edge of the image is 2 mm.

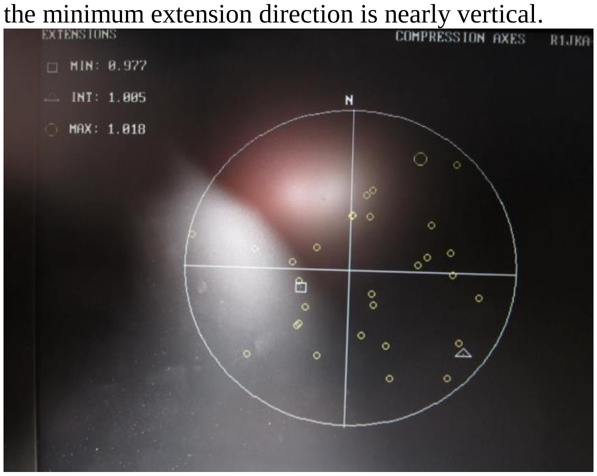
Above is Fig. A: a brachiopod shell (**B)**(uncrossed)**.** Note that there is no isopachous cements, so the top of the photo is up. The shell shows no apparent thickening due to rotation about an axis parallel to the dip direction.



Above is Fig. B of a bedding parallel stylolite (**S)** as seen in cross-polarized light. On the following page is a crinoid columnal (Cr) (uncrossed). Its shape is rectangular. Rotations about an axis parallel to the proposed dip direction would make the columnal more square in appearance or show the cylindrical nature of the columnal.



These results are consistent with the above assumption that the slide is a vertical slice along the dip direction. Core JK1 is from the center of Jeptha Knob, so for a meteorite impact the minimum extension direction should be oriented vertically, when bedding is rotated to horizontal [5]. Below are our preliminary calcite-strain-gauge results rotated to horizontal and it shows the minimum extension direction is nearly vertical.



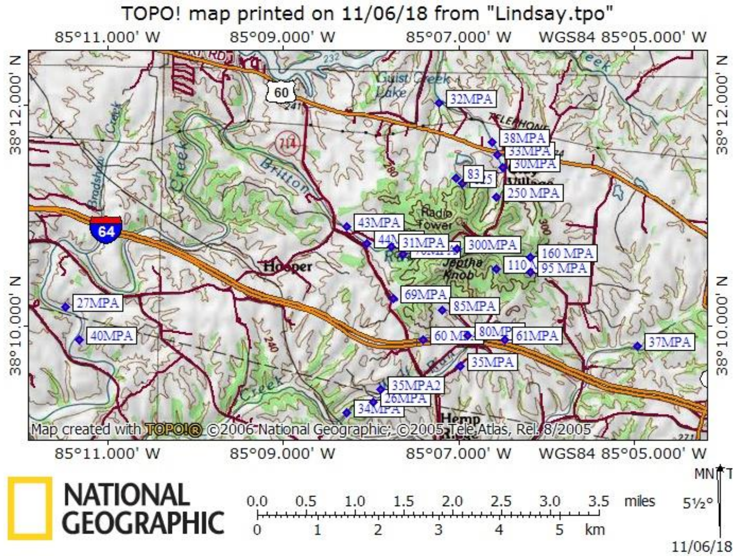
Note that the Turner-Compression axes generally don't lie along bedding consistent with impact [5].

Below are the updated differential stresses for the core JK1 [1].

Table 1: Inferred Differential Stresses (σ_1-σ_3) from calcite.

Sample	Depth (m)	≥1 twin (MPa)	≥2 twin (MPa)	3 twin (MPa)	1σ (%)
JK1-3	187	53	220	180	5.0
JK1-4	198	240	440	570	7.4
JK1-5	200	125	400	170	3.9
JK1-6	213	∞	∞	570	4.7
JK1-7	218	∞	670	400	4.1
JK1-8	220	130	290	190	5.7

Given the shallow depth, 200-400m, at the time of twinning these high differential stresses cannot be explained by tectonic processes and meteorite impact is the best explanation [1]. Below shows differential stresses at Jeptha Knob and vicinity.



Within the mapped deformation [6] differential stresses are ≥60 MPa and differential stresses increase towards the center of the structure consistent with an impact origin [5]. Outside the mapped deformation differential stresses are 25-40 MPa, consistent with differential stresses associated with the Alleghenian Orogeny [7].

References:

[1] Schedl, A. D. and Seabolt, A. (2016) *LPS XXXXVII,* Abstract #1589. [2] Seeger, C. R. (1968) *AJS, 266*, 630-660. [3] Jamison, W. A. and Spang, J. H., (1976) *GSA Bull., 87*, 868-872. [4] Groshong, R. H., Jr. (1972) *GSA Bull., 82*, 2025-2038. [5] Schedl, A. D. (2006) *EPSL, 244*, 530-540. [6] Cressman, E.R. (1981) *USGS Prof. Paper 1151-B*, 16 p. [7] Craddock, J. P. et al. (1993) *Tectonics, 12*, 257-264.