STRUCTURE OF THE BREVARD ZONE AND BLUE RIDGE NEAR LENOIR, NORTH CAROLINA, WITH OBSERVATIONS ON OBLIQUE CRENULATION CLEAVAGE AND A PRELIMINARY THEORY FOR IRROTATIONAL STRUCTURES IN SHEAR ZONES

by

Andy R. Bobyarchick

A Dissertation

Submitted to the State University of New York

at Albany

in Partial Fulfillment of

the Requirements for the Degree of

Doctor of Philosophy

College of Science and Mathematics

Department of Geological Sciences

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ABSTRACT

Stratigraphy on the eastern flank of the Southern Appalachian Blue Ridge near the Grandfather Mountain window is arranged in a series of fault-bounded lithotectonic belts stacked so that the structural section dips steeply southeast. The Fries block of the Blue Ridge thrust sheet overlies the Grandfather Mountain window along the Linville Falls fault. The Laytown belt overlies the Fries block along the Winding Stairs Mountain fault. The Brevard zone, bounded at its base by the Ripshin Mountain fault and bounded at its top by the Yadkin fault, lies on the Laytown belt. Augen gneiss and granitic gneiss of the Inner Piedmont, here called Henderson gneiss, sharply abuts the Brevard zone along the Yadkin fault. It is unlikely that any coherent stratigraphy exists in the Brevard zone.

All principal foliations in the Grandfather Mountain window, Blue Ridge thrust sheet, and Brevard zone are the result of the transposition of an earlier layering or foliation. Brevard zone mylonites commonly show isoclinally refolded isoclines. The mylonitic foliation there is the culmination of multiple deformation. Distinct zones in the Fries block contain a superimposed cleavage that results in locally transposed, mylonitic shear zones. These shear zones are sites for retrograde metamorphism and they are interpreted to be faults, possibly splays off a thrust that may emerge as the Linville Falls fault. Lineations were produced as a result of transposition. The principal lineation in the Grandfather Mountain window is older than the principal lineation in the Blue Ridge and the Brevard zone. Interpretations of shear sense in the Brevard zone

based on orientations or reorientations of the lineations are not appropriate.

Shear across low angle oblique crenulation cleavage is consistently dextral in the Brevard zone. The cleavage event is interpreted to have occurred in the latter stages of late Paleozoic ductile deformation and retrograde metamorphism in the Brevard zone. The cleavage geometry suggests dextral strike-slip motion on the Brevard zone.

Theoretical models for irrotational structures in two-dimensional plane strain demonstrate that: (1) lines of material particles lying in an oblique irrotational orientation make an angle, α, with the shear zone boundaries whose vertex indicates the shear sense for the simple shear component and (2) the oblique irrotational direction could experience a component of simple shear equal in sign to that of the shear zone.

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Research Methods and Funding

Mapping, at the scale of 1:24,000 was conducted in March and June of 1981 and in April and May of 1982. Base camps for the 1981 season were motels near the field area whereas camps for the 1982 season were tent sites in nearby campgrounds. Foot and road traverses were the principal means of collecting field data. It was found that the best exposures in the Blue Ridge were, in order of quality, road-side outcrops, major stream banks, and ridge crests. Most intermittent and dry stream valleys are filled with colluvium and other debris. Individual outcrops are not shown on Figure 2-1 because the areas underlain by most exposures are too small. Except for a few ridge crests, all outcrops are represented by structure symbols.

Approximately 150 petrographic thin sections were examined throughout the course of research. Of these, probably about 75 sections could be considered informative.

Funding for research in the Brevard zone came from the Department of Geological Sciences at SUNYA, the SUNYA Benevolent Association, Sigmi Xi, the Geological Society of America's Penrose Fund, and from the author's own pocket. Additional funding was provided by 1982 summer employment with the U.S. Geological Survey. The author is indebted to that agency and, in particular, to Louis Pavlides for the opportunity.

Two other experiences contributed to the author's professional education. One experience was a 1980 field season spent studying the neo-tectonics of eastern Anatolia. That work led to a better understanding of the relationships between active and dead mountain belts.

The research was funded by a NASA grant to John Dewey and Kevin Burke at SUNYA. The second experience was the author's participation in a Penrose Conference on mylonites held in San Diego, California, in 1981. The 10 days spent at the conference were especially informative. The opportunity was provided by a SUNYA Benevolent Association Fellowship.

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