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See table of contents

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Tectonic Studies in the Cobequid Mountains
Nova Scotia*

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The Cobequid Mountains are presently a target of geological investigations carried out by D.G. KELLEY as part of the regional geology program of the GEOLOGICAL SURVEY OF CANADA (KELLEY, 1963, 1964, 1965). During the field seasons of 1965 and 1966, Kelley was joined by G.H. EISBACHER who concentrated on dynamic and kinematic analysis of structures along the "Cobequid Fault" (WEEKS, 1948) and their relationship to deformation patterns within the pre-Carboniferous Cobequid rock complex.

The results of Eisbacher's work will constitute the basis for a Ph.D. thesis to be submitted to the Department of Geology, PRINCETON UNIVERSITY. It will deal with structures in an area of about 400 sq. miles between Wentworth Valley and Parrsboro (see Figure 1).

In the field the authors attempted to delineate belts of rock characterized by distinct deformational mechanisms (closed kinematic systems), and to compare these with known and inferred stratigraphic surfaces. Several such kinematic units were recognized and their regional significance synthesized in terms of translations, rotations and strain. The most useful tectonic elements for the kinematic interpretation of "missing stratigraphic links" and mappable offsets were fracture patterns, the orientation of diabase dykes, discrete slickensided surfaces of failure, penetrative s-surfaces and mineral lineations, mesoscopic folding, cleavage-bedding intersections, boudinaged and striated beds, and intensely fractured clasts in conglomerate.

Laboratory work by Eisbacher, now in progress, includes universal-stage petrofabric analysis of mica and quartz tectonites. These tectonites form the bulk of rocks in a broad west-trending mylonite-schist zone which contains both sedimentary and igneous rocks (Figure 1).

The pre-Carboniferous rocks of the Cobequids comprise a dioritic-granitic "core" complex, and clastic sedimentary rocks and volcanics of very low metamorphic grade. The clastics include fossiliferous strata of Silurian and Devonian age. An assemblage of Lower Devonian andesitic flows and rhyolitic welded tuffs are the youngest rock group within the part of the Cobequids presently investigated.

Carboniferous mudstones, sandstones, and conglomerates transgressively onlap, and in places are faulted against, the pre-Carboniferous rocks. Preliminary analysis of the data suggests that the relationship of the "Cobequid arch", in its present configuration, to the adjacent Carboniferous and Triassic basins, is not one of a block uplifted vertically against its

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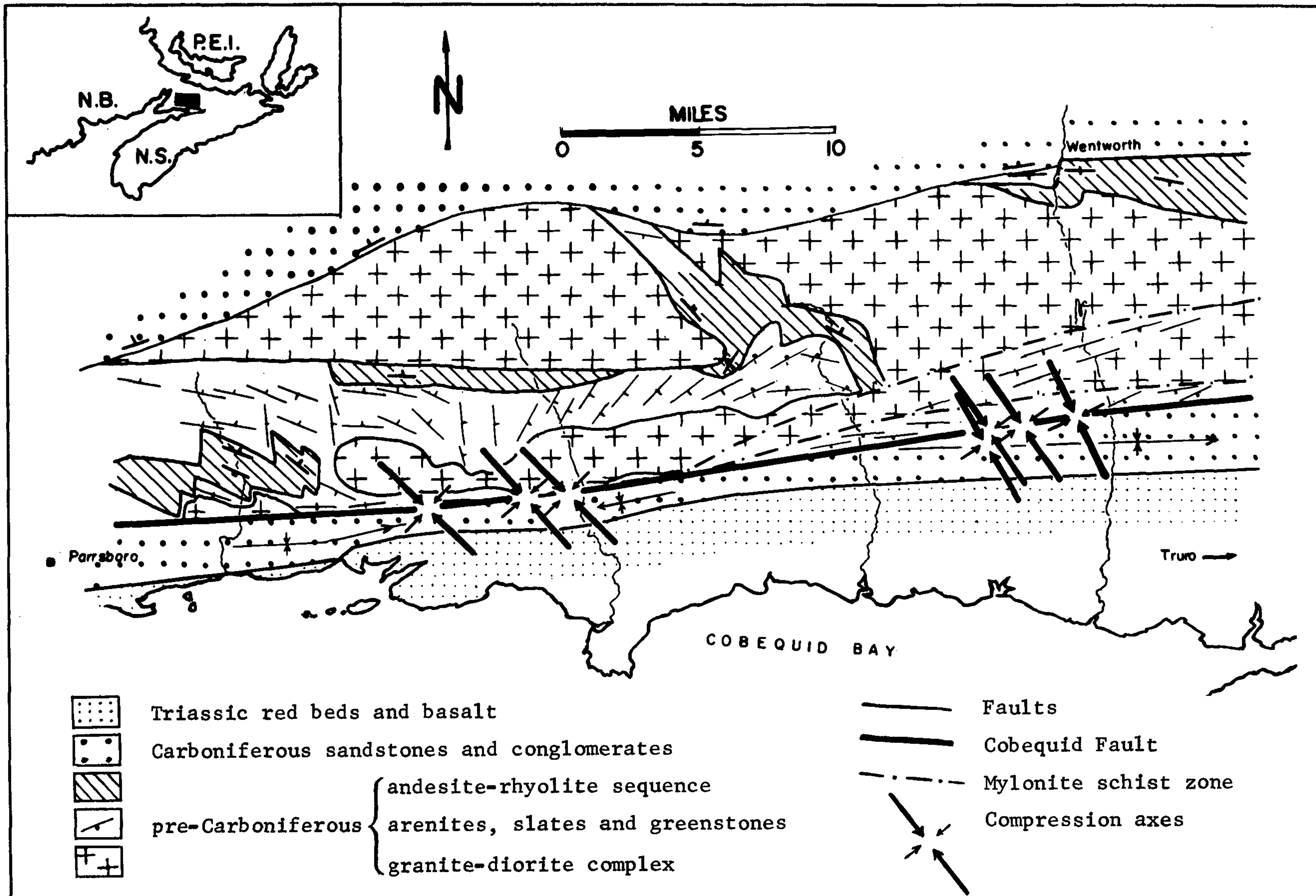

Figure 1. Tectonic units of the central Cobequid Mountains

sedimentary cover. Mechanisms of a more complicated nature took place. The following arguments are used to illustrate this point:

1. Within the area studied, no overthrusts of Cobequid rocks onto Carboniferous strata were observed. No mesoscopic structures indicate pure dip-slip components anywhere along fault zones.

2. The fault zone along the southern margin contains slices of fractured granitic rocks, brought into contact with sedimentary rocks along very gently plunging trajectories. These trajectories are suggested by steeply plunging folds with right lateral drag in the contact areas. Carboniferous clastics are faulted against this zone of dislocation and tectonic elements (e.g. striations on boudins) in the adjacent zone of phyllonitisation point to a strong right-lateral, strike-slip component for the overall process of displacement.

Similar displacement vectors seem to be associated with the penetrative mineral lineation of the mylonite-schist zone. The rotational sense of micas in quartz tectonites suggests that the lineation is the principal direction of tectonic transport during the process of mylonitisation. The geological environment for this type of deformation must have differed from the one mentioned above; here granitic and dioritic rocks are intensively deformed on an intragranular scale, resulting in regionally persistent patterns of preferred orientation for the c-axes of quartz, identical to those reported from the other zones of large strain (e.g. BALK 1952, CHRISTIE 1963).

3. In some places, where Carboniferous conglomerates are faulted against the "basement" rocks, well-rounded clasts show intensive systematic fracturing very similar in nature to those reported by RAMSAY (1964) from the Highland Boundary Fault in Scotland. The fractures within the clasts originate at the points where indentation by other pebbles takes place during a phase of overall compression. By careful measurement of the fracture planes, the orientation of the principal stress axis can be derived for the mechanism of failure within the individual clasts. Statistical study of many fractured pebbles and cobbles in several outcrops along the Cobequid Fault led to the construction of regional compression axes shown on Figure 1. Characteristically, the axes of maximum compression are not perpendicular to the trace of the fault, but they show a pattern one would expect from the sub-horizontal displacement vectors in the phyllonitic rocks immediately north of the fault. On the basis of this evidence, post-Early Pennsylvanian (?) compressive stresses of regional significance must have existed in the area.

The problem of large vertical offsets in the configuration of pre-Carboniferous "basement" units still needs careful consideration, but it has to be pointed out that vertical displacements are necessarily associated with horizontal motions if the mechanical system is closed.

For the reasons given above, a Basin-and-Range structural prototype with a rigid basement block being lifted against its sedimentary cover is not applicable to the Cobequid Mountains. Major internal adjustments of units with different mechanical behaviour were as important as the interaction of pre-Carboniferous "basement" with the Carboniferous sedimentary rocks in the deformation history of the region.

Further work will gather more data on the regional extent of the Cobequid Fault zone as related to other zones of discontinuous displacement within the Maritime Provinces, and give an idea of the direct influence of tectonics on the development of sedimentary basins in northern Nova Scotia.

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