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SUTTON MAP-AREA, QUEBEC

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By

P.R. Eakin

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The map-area covers an important stratigraphic and structural part of the western Appalachian Mountain system of southern Quebec. The type localities for most of the formations listed in the legend lie within the area and were described originally by Clark[1].

Outcrops abound in the east-central part of the map-area along the Pinnacle Mountain anticline ("Enosburg Falls anticline" of Cady[2]), a major subsidiary structure of the Green Mountain anticlinorium; in the rest of the area they are less numerous, and in the Sutton Mountains exposures are scarce in heavily wooded parts. Most of the formations are easily distinguished, even at a-distance, because of their characteristic colours and differing resistance to weathering. Dolomites of the Oak Hill Group (4, 6) weather rapidly along joints and are typically masked by shrubbery. In the St. Germain Complex, many low, rounded, rubbly outcrops are readily found in newly cleared and ploughed fields, but elsewhere are thinly mantled by soil and vegetation.

The part of the Oak Hill Group above the lavas of the Tibbit Hill Formation exhibits a sedimentary sequence from slates through sandstones to carbonate rocks in two and a half cycles. The formations of the Oak Hill Group are structurally conformable with each other, but there is evidence of local disconformities at the base of the Pinnacle and the West Sutton Formations (3, 5). Lateral changes in thickness and lithology are marked. Thus, the Gilman Formation (5) changes from a relatively clean, fine-grained quartzite eastward through a phase of alternating sandstone and shaly siltstone to a sericite phyllite in the Sutton Mountains. The lower formations of the Oak Hill Group appear considerably thinned east of the Pinnacle Mountain anticline in an ill-defined band, originally mapped as the "Mansville Phase"[1] along the western margin of the Sutton Schists (1). The thinning of the formations may be all, or in part, a result of intense deformation along the Richford-Sutton syncline ("Cambridge syncline" of Cady[2]), where the folds are mainly isoclinal. Stratigraphic thicknesses in the Oak Hill Group have not been determined accurately because of structural complexity. The following figures are tentative: Call Mill Formation, 1 foot to 100 feet; Pinnacle Formation, about 400 feet; White Brook Formation, 20 to 75 feet; West Sutton Formation, 40 to 60 feet; Gilman Formation, about 1,000 feet; Dunham Formation, 50 to 150 feet; Sweetsburg Formation, about 300 feet. In aggregate, these formations have an average thickness of about 2,000 feet.

Structural and stratigraphic relations between the St. Germain Complex (17) and the Sweetsburg Formation (7) have not been clearly defined by field work. Clark suggested that the two formations

are separated by a major thrust, but the evidence for this fault is not convincing. Thrust faults, however, may be present locally. The St. Germain Complex (17) consists of folded and faulted carbonate rocks and shales which have not been mapped separately because of scarcity of outcrops and complicated local structural relations.

Evidence of submarine sliding in the Stanbridge Formation (17) appears in the limestone quarry near Sweetsburg, but the extent and distribution of such slides are not known.

Structure of the formations is relatively simple in its broader aspects, but much more complex in detail. Abundant evidence indicates at least two phases of deformation with two contrasting styles of folds, and at least two sets of cleavages and lineations. Cleavage and schistosity pervade most rocks and, in places, almost entirely destroy primary structures such as bedding. For example, in the Gilman Formation (5) thin sandstone beds interbedded with siltstone have been reduced to small drawn-out lenses scattered through phyllite. The earliest recognized foliation is a slaty cleavage associated with asymmetric folds in the western two thirds of the map-area and a well-developed schistosity, parallel or subparallel with bedding, in the Sutton Schists in the eastern third of the map-area. The relationship of the slaty cleavage to schistosity is not known. The early, asymmetric folds have gently dipping east limbs and steep to overturned west limbs; they are believed to be associated with thrusting of the Sillery Formation (8) westward onto the younger St. Germain Complex (17). Early, minor, generally east-trending cross-folds and lineations are abundant in the Sutton Schists (1) but their significance is not clear. Cross-folds are also common in the St. Germain Complex (17).

The latest deformation produced upright open folds in the lower Oak Hill Group and Sutton Schists (1). The Sutton anticlinorium, the Pinnacle Mountain anticline, and the closed Richford-Sutton syncline were formed at this time. Axes of the folds trend and gently plunge northeast. A prominent slip cleavage parallels the axial planes of these folds. Some of the peculiar fold-forms in the upper Oak Hill Group in the central part of the map-area apparently originated by superposition of later weakly developed upright folds upon earlier asymmetric folds.

The degree of metamorphism increases gradually from the central part of the map-area eastward to the Green Mountain axis where it reaches the upper limit of the greenschist facies.

Apart from the Brome Mountain stock of Cretaceous age[3], igneous bodies are rare. Narrow dykes associated with the stock are exposed in about a dozen places in the eastern half of the map-area.

Small discontinuous bodies of serpentinite too small to appear on the map occur in the Sutton Schists (1).

Sparsely disseminated pyrite with minor chalcopyrite and bornite occur in small discontinuous zones of sheared and fractured rocks of the lower formations of the Oak Hill Group. These copper showings were explored in the 19th Century by shallow shafts and other workings. Several small bodies of sparsely disseminated galena and sphalerite occur in Dunham dolomite (6) north of Hunter Mills.

Magnetite and hematite are conspicuous in the Pinnacle and West Sutton Formations (3, 5), but no deposits of commercial interest have been found.

Talc and soapstone are present in a few exposures of the Sutton Schists (1) and may be of future commercial interest. Limestone for chemical and cement-making purposes is quarried near Sweetsburg and Bedford.

References

[1] Clark, T.H.: Structure and stratigraphy of southern Quebec; Bull. Geol. Soc. Amer., vol. 45, pp. 1-20 (1934).

[2] Cady, W.M.: Stratigraphy and geotectonic relationships in northern Vermont and southern Quebec; Bull. Geol. Soc. Amer., vol. 71, pp. 531-576 (1960).

[3] Fairbairn, H.W.: "Past and present magnitude of Sr^{87}/Sr^{86} in rocks and minerals of the Monteregian igneous province, Quebec" in Hurley, P.M., et al., Variations in isotopic abundances of strontium, calcium, and argon and related topics; U.S. Atomic Energy Comm., Tenth Ann. Prog. Rept. for 1962, NYO 3943, pp. 55-60 (1962).