

REPLY

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The comment on my paper by Pajari, Pickerill, and Currie raises two main issues, the significance of the sub-Davidsville unconformity and the distribution of sedimentary facies in the Baie d'Espoir, Gander, and Davidsville Groups.

On the subject of the unconformity, it is necessary first to define our point of disagreement. I do not dispute that the rocks of the Gander River Ultrabasic Belt were exposed at the Earth's surface in Late Llanvirn-Early Llandeilo time. Furthermore I agree that the Davidsville Group was deposited unconformably upon them. I disagree with the use of the unconformity by Currie, Pajari, and Pickerill (1979) to date the tectonic emplacement of the ultrabasic belt against the Gander Group and the deformation of the latter.

It is my view that that Gander and Davidsville Groups are probably approximate time equivalents of Early to Middle Ordovician age and that they were deposited on a basement that was composed in large part of oceanic crust. I do not find it incongruous that part of this oceanic crust includes ultrabasic rocks that were exposed during the Ordovician. There are numerous examples of ultrabasic rocks exposed on modern-day ocean floors, along fracture zones and transform faults (for example, Shand, 1949; Miyashiro, Shido, and Ewing, 1969; Fox and Opdyke, 1973; Francheteau and others, 1976; Bonatti and Hamlyn, 1978). Of these, probably the most famous are those that protrude above sealevel to form St. Paul's Rocks near the Mid-Atlantic ridge (Darwin, 1876; Melson and others, 1967).

I have proposed that it was not until the Silurian-Devonian Acadian orogeny that ultrabasic rocks of the Gander River belt came into tectonic contact (as opposed to sedimentary contact) with the Gander Group, and it was not until this orogeny that the Davidsville and Gander Groups were deformed. It is on the timing of this *tectonic* emplacement that I disagree with Currie, Pajari, and Pickerill (1979). My proposed timing of events was based mainly on the correlation of episodes of deformation (Colman-Sadd, 1980, p. 1012). It is supported by recent mapping (Blackwood, 1980 and in press), which shows ultramafic rocks in fault contact with the Davidsville Group and completely surrounded by it. Emplacement of some ultramafic rocks must, therefore, have postdated the sub-Davidsville unconformity. The proposed timing of Currie, Pajari, and Pickerill (1979) would necessitate two periods of emplacement. While this is not impossible, I consider it less likely than my alternative. The observations listed by Pajari, Pickerill, and Currie would appear to be the evidence in favor of the earlier, pre-Davidsville, period of emplacement. For the following reasons these observations fail to prove that the earlier event ever occurred and so do not contradict my proposal of Acadian emplacement:

1. Observations A, B, and D indicate that Davidsville Group sediments were deposited unconformably on the Gander River Ultrabasic Belt in Late Llanvirn-Early Llandeilo time. Observation B may perhaps indicate substantial topographic relief on the Ordovician ocean floor, which could be expected if this was the location of a fracture zone (compare St. Paul's Rocks). Since the unconformity has not been observed to extend across or truncate the fault between the ultrabasic belt and the Gander Group, it cannot be used to date the fault or the deformation in the Gander Group (fig. 1).

2. Observation C is also inconclusive. First, given anything less than complete exposure, it is difficult to be absolutely certain that it is a valid observation. Faults are commonly unexposed, and the mapping of Blackwood (1980) shows that at least some of the faults related to ultramafic emplacement do cut the Davidsville Group. Even assuming observation C is valid, it still does not indicate when the ultrabasic rocks were faulted against the Gander Group or when the Gander Group was deformed. The sedimentary rocks of both the Davidsville and Gander Groups are isoclinally folded (Kennedy and McGonigal, 1972; Pickerill and others, 1978), and the relationship could be attributed to structural disharmony. Deformation may have produced faulting in the basement rocks, while at the same time the more ductile overlying sediments reacted by folding (Jackson, 1980).

With regard to the detritus in the North Steady Pond Formation, I know of no ultrabasic fragments nor have I indicated any in figure 4 (Colman-Sadd, 1980).

The turbidites of the North Steady Pond and St. Josephs Cove Formations are indeed similar to those of the Davidsville Group. I agree that they may all be part of the same submarine fan complex, which is why I designated them as channel, mid-fan, and lower fan deposits (Colman-Sadd, 1980, p. 1002). Such a model also explains the lack of any slope, mid, or upper fan turbidites between the St. Josephs Cove and Riches Island Formations. The absence of these facies suggests that the principal sediment source for the St. Josephs Cove Formation was not from the southeast. It supports the proposition that these sediments were derived

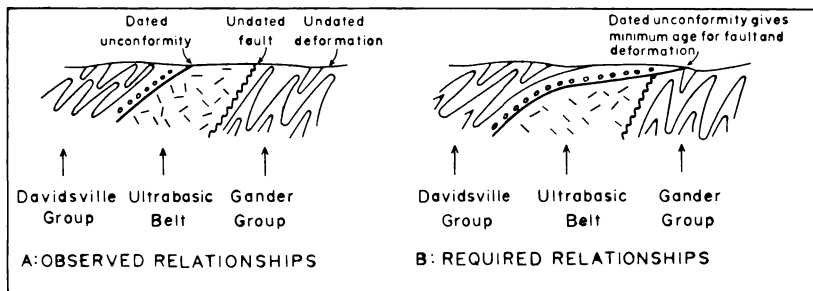


Fig. 1. Schematic representation of stratigraphic and tectonic relationships along the Gander River ultrabasic belt. (A) observed relationships; (B) relationships required to prove the timing of events proposed by Pajari, Pickerill, and Currie.

from the northwest and form the lower part of a submarine fan that also includes the North Steady Pond Formation. Alternatively it is possible that they may have been deposited by axial, southwesterly flowing currents (Colman-Sadd, 1980, p. 1002-1003).

The interpretation of the sedimentary environment for the Riches Island and Isle Galet Formations should be regarded as tentative, given the polydeformed and metamorphosed state of these rocks. If they are shelf deposits, the adjacent landmass seems to have contributed much less sediment to the Baie d'Espoir Group than did the central Newfoundland island arc, perhaps because of more subdued topography. The fine-grained graphitic and pyritic sediments are indeed unusual deposits for a shelf environment, but the widespread occurrence of volcanic rocks, with which these sediments are closely associated, indicate that the environment was subject to some unusual controls.

REFERENCES

- Blackwood, R. F., 1980, Gander (Mount Peyton East) map area (2D/15): Newfoundland Dept. Mines and Energy, Mineral Devel. Div Map 80198.
- , in press, Geology of the Gander (2D/15) and Gander River (2E/2) area: Newfoundland Dept. Mines and Energy, Mineral Devel. Div. Rept. 82-4.
- Bonatti, E., and Hamlyn, P. R., 1978, Mantle uplifted block in the western Indian Ocean: *Science*, v. 201, p. 249-251.
- Colman-Sadd, S. P., 1980, Geology of south-central Newfoundland and evolution of the eastern margin of Iapetus: *Am. Jour. Sci.*, v. 280, p. 991-1017.
- Currie, K. L., Pajari, G. E., Jr., and Pickerill, R. K., 1979, Tectono-stratigraphic problems in the Carmanville area, northeastern Newfoundland, in *Current Research, Part A: Canada Geol. Survey Paper 79-1A*, p. 71-76.
- Darwin, C., 1876, Geological observations on the volcanic islands and parts of South America visited during the voyage of H. M. S. Beagle: London, Smith Elder and Co., 647 p.
- Fox, P. J., and Opdyke, N. D., 1973, Geology of the oceanic crust: magnetic properties of oceanic rocks: *Jour. Geophys. Research*, v. 78, p. 5139-5154.
- Francheteau, J., Choukroune, P., Hekinian, R., Le Pichon, X., and Needham, H. D., 1976, Oceanic fracture zones do not provide deep sections in the crust: *Canadian Jour. Earth Sci.*, v. 13, p. 1223-1235.
- Jackson, J. A., 1980, Reactivation of basement faults and crustal shortening in orogenic belts: *Nature*, v. 283, p. 343-346.
- Kennedy, M. J., and McGonigal, M. H., 1972, The Gander Lake and Davidville Groups of northeastern Newfoundland: new data and geotectonic implications: *Canadian Jour. Earth Sci.*, v. 9, p. 452-459.
- Melson, W. G., Jarosewich, E., Bowen, V. T., and Thompson, G., 1967, St. Peter and St. Paul Rocks: a high temperature, mantle derived intrusion: *Science*, v. 155, p. 1532-1535.
- Miyashiro, A., Shido, F., and Ewing, M., 1969, Composition and origin of serpentinites from the Mid-Atlantic Ridge near 24° and 30° north latitude: *Contr. Mineralogy Petrology*, v. 23, p. 117-127.
- Pickerill, R. K., Pajari, G. E., Jr., Currie, K. L., and Berger, A. R., 1978, Carmanville map-area, Newfoundland; the northeastern end of the Appalachians, in *Current Research, Part A: Canada Geol. Survey Paper 78-1A*, p. 209-216.
- Shand, S. J., 1949, Rocks of the Mid-Atlantic Ridge: *Jour. Geology*, v. 57, p. 89-92.