The age of the Roberts Arm Group, north-central Newfoundland: Discussion

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The radiometric ages recently reported by Bostock *et al.* (1979) for the Roberts Arm Group provide an important new constraint for evolutionary models of the Newfoundland Appalachians. Furthermore, they represent the first independent evidence for the age of the broad belt of calc-alkaline submarine volcanic rocks in central Newfoundland that includes the island's richest base metal deposits. The Middle Ordovician age that they report, however, does not agree with the Silurian age that has previously been assigned to these rocks on the basis of regional field relations (e.g., Strong 1977; Dean 1978). Since the correct choice between these possibilities is crucial to our understanding of the evolution of this terrain, a brief discussion of the field relations bearing on the problem seems warranted.

The Roberts Arm Group is part of an elongate

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belt of submarine calc-alkaline volcanic rocks that includes the Buchans Group, Roberts Arm Group, Cottrells Cove Group, and Chanceport Group (Strong 1977). Following the example of Dean (1978), this entire belt of rocks is informally referred to here as the Roberts Arm belt. Along its entire length the Roberts Arm belt lies immediately to the west or north of thick clastic sequences which themselves face grossly west or north (Dean 1977*a*). Since these clastic sequences are known to be of Upper Ordovician to Lower Silurian age, on the basis of fossil evidence (Bergstrom *et al.* 1974), it was reasonably inferred that the "overlying" volcanics of the Roberts Arm belt were Silurian in age (Dean 1977*b*; Strong 1977). Recent field work by the authors and others, however, indicates that a conformable contact cannot be demonstrated in the field. In western Notre Dame Bay the Roberts Arm Group is separated from the Upper Ordovician greywacke–shale sequence to the southeast by a 1 km wide belt of chaotically deformed rocks (Sops Head Complex of Dean (1978)), across which stratigraphic continuity cannot be demonstrated (Nelson 1978). Furthermore, this mélange belt is itself clearly faulted against the Roberts Arm Group at Sops Head. Further to the east in Notre Dame Bay, the Cottrells Cove and Chanceport Groups are separated from the Upper Ordovician to Silurian greywacke–shale sequences to the south by the Lukes Arm fault (Horne and Helwig 1969). Locally in this area, a narrow belt of chaotically deformed rocks, identical to those further west, occurs along the trace of the fault zone (Boones Point Complex of Helwig (1967)). In the interior of central Newfoundland, the contact between the Buchans Group on the west and Upper Ordovician to Silurian greywacke–shale sequence to the east is not exposed. However, it is generally expressed topographically as a till-covered depression that could represent a fault (Baxter Kean, personal communication, 1978). It is clear, therefore, that nowhere has a conformable contact been demonstrated between Upper Ordovician to Silurian clastic rocks below, and volcanics of the Roberts Arm belt above. Furthermore, where the contact between these two units is observable in the field, it is faulted. In view of these relations, the Middle Ordovician (~455 Ma) age reported by Bostock *et al.* (1979) for the Roberts Arm Group is entirely reasonable.

In the discussion of the significance of their results, Bostock *et al.* (1979) note that the age they obtained for the Roberts Arm Group is roughly coincident with the age of the Caradocian black slate horizon that occurs throughout the Notre Dame Bay area. As they point out, however, the uncertainties inherent in the radiometric age determination and in the absolute calibration of the Ordovician time scale are such as to allow the Roberts Arm Group to be slightly older or younger than the Caradocian black slate. Although they do not attempt to discriminate between these possibilities, consideration of the stratigraphic evolution and provenance of the clastic sequence adjacent to the Roberts Arm belt suggests strongly that the first hypothesis is correct.

Throughout the Notre Dame Bay area this clastic sequence begins at the base with graptolite-bearing Caradocian black slate. This, in turn, passes upward conformably into interbedded greywacke turbidites and shales of Ashgillian age (Sansom Formation and equivalents), which in turn interdigitate with, and are conformably overlain by, Llandoverian plutonic cobble conglomerates (Goldson Formation). These are locally overlain by terrestrial red beds and silicic volcanics (Botwood Group). It has long been recognized that this sequence represents the infilling of a sedimentary basin that commenced in the Caradocian and was concluded in the Silurian, by which time terrestrial conditions had been achieved (for example, Williams 1967). Paleocurrent and paleoslope data, and clast lithologies within the conglomerates, all indicate that this sedimentary fill was derived from the north and (or) west (Helwig 1967; Horne 1968; Helwig and Sarpi 1969; Nelson unpublished data). The arrival of this material, beginning in Caradocian time, documents the uplift and subsequent subaerial erosion of a terrain that must have existed somewhere to the north and (or) west of the sedimentary basin, i.e., in a direction now occupied by the Roberts Arm belt. It is difficult to imagine how these sediments could be derived from or even transported across a terrain that was itself accumulating upwards of 5 km of submarine volcanics (Dean 1978). Clearly, from a geologic point of view, it is more reasonable to suggest that the Roberts Arm belt was formed prior to deposition of the Caradocian black slate, and that it, along with areas farther to the west, was subsequently uplifted to form the source terrain for the Upper Ordovician to Silurian sediments preserved in Notre Dame Bay.

As Bostock *et al.* (1979) have noted, a pre-Caradocian age for the Roberts Arm belt would indicate that it formed contemporaneously with the pre-Caradocian volcanic–volcaniclastic sequence that occurs throughout the Notre Dame Bay area. As they have further noted, this interpretation sug-

gests a relation between the end of volcanism in Notre Dame Bay and the obduction of the western Newfoundland allochthons (Dean and Strong 1975; Dean 1978; Nelson and Casey 1979).

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