matters arising

Orogenic zones in central Australia

DUFF and Langworthy[1] present a number of arguments purporting to confound any suggestion of a subduction model[2] for the Giles Complex–Woodroffe Thrust Zone located along the contact of the Amadeus Basin with the Musgrave Block. During the orogeny associated with this contact, the Petermann Range orogeny[3], the north-recumbent nappes developed and thrusting occurred. I have confined my arguments in all instances to this orogenic belt. Any later orogeny, for example, the Alice Springs orogeny, affecting other regions may well be explained otherwise.

A fundamental argument presented by Duff and Langworthy relates the time of the orogeny to palaeomagnetic evidence indicating that the Arunta and Musgrave Blocks have moved as a single unit since the late Proterozoic or early Palaeozoic. Even if the palaeomagnetic data[4] are accepted, a subduction model is in no way contravened, as geochronological evidence clearly indicates that the Petermann Range orogeny occurred about 1,110–1,150 Myr ago. Duff and Langworthy have quoted Forman[3] as specifying an age of 600 Myr for this orogeny. Forman gives radiometric ages from specimens collected from the Petermann Ranges and these figures, together with an age given by Wilson and Green[5] for an adamellite intrusion in the Musgrave Block, are shown in Table 1. The granitic rocks show intrusive contacts with folded quartzites[3] in the Petermann Range area.

The question then is whether the whole rock age or the biotite age is taken as dating the orogenic episode. Most authorities now regard biotite ages as excessively low because of the low blocking temperature of this mineral[7]. The biotite age is probably indicative of a late stage of cooling of the crystalline rock and this could be related to uplift and erosion. The whole rock age is generally accepted as the age of initial crystallisation, so it is this age that is correlated with the tectogenic–orogenic episode. If the Petermann Range orogeny is some 1,100–1,150 Myr old, the Arunta and Musgrave Blocks would have moved as a unit from this time onwards, in keeping with the palaeomagnetic evidence.

Duff and Langworthy list features that they claim do not occur in the Petermann Range orogenic belt, thus disproving a subduction model for this region. In this respect, note that acid intrusives, for instance, occur within the orogenic belt[3]. It has been argued elsewhere that the Giles Complex may well be segments of an ophiolite sequence and it has reasonably been suggested that the extent of representation of certain criteria indicative of subduction, for example, blue-schist facies rocks and calc-alkaline volcanics is very much dependent on the depth of erosion[2]. Erosion would be considerable in Precambrian orogenic belts. Rocks outcropping in the Petermann Range orogenic belt have formed under high pressures and temperatures, that is, at deep crustal levels, so low-temperature and low-pressure rocks are unlikely to be found *in situ*, but this does not mean that such rocks did not form.

Table 1 Radiometric ages for the Petermann Ranges and for an intrusion in the Musgrave Block

Rock types	Age (Myr)	Method*
Granitic gneiss	1,190 (whole rock)	Rb/Sr (3)
	600 (biotite)	
Biotite granite	1,150 (whole rock)	Rb/Sr (3)
	600 (biotite)	
Adamellite	1,123 (whole rock)	Rb/Sr (5)
	1,094 recalculated	(6)
	1,077–1,092	K/Ar (6)

*Numbers in parentheses indicate source reference no.

The presence of possible examples of ensialic mobile belts within African and North American cratonic regions[8] does not preclude the possibility of other orogenic types in specific locations within the Australian craton. It seems to me that a subduction model more than reasonably fits the data available in these areas for the Petermann Range orogeny. Present-day intraplate tectonic compression[9] does not support the argument for ensialic orogeny unless a correlation can be shown between regions of intraplate compression and regions of thick sedimentation of a specific nature and with igneous activity. This constraint is met by regions of present-day subduction and continental shelf regions and thus these zones can be used as models for past geological events.

In conclusion, in the case of the Petermann Range orogeny the ensialic concept does not explain the following features: the major lithological and structural differences of the basement rocks in contact along the thrust zone the mafic/-ultramafic zone; the significance and emplacement of the Giles Complex; the asymmetric nature of nappe distribution and the recumbency of these structures to the north; the spatial and temporal distribution of discrete tectonic elements from south to north. It also seems that the most critical data in the future will be palaeomagnetic and geochronological data relating to the Arunta and Musgrave Blocks specifically.

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DRS DUFF AND LANGWORTHY REPLY—Davidson[1,2] believes that a simple plate-subduction model explains certain features of the Musgrave Block, adducing support solely from the alleged similarity of sections through the central Australian shield with 'cartoon' plate-tectonic sections[3]. He argues[1,2] that the usual features of plate-edge tectonism—pillow basalts, pelagic sediments, calc-alkali volcanics,

Matters arising

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