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# Discussion on "Early tectonic extension between the Agulhas Bank and the Falkland Plateau due to the rotation of the Lafonia microplate", by Z. Ben-Avraham, C.J.H. Hartnady and J.A. Malan

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Ben-Avraham et al. [1] present evidence for a deep sedimentary basin of Upper Jurassic to Tertiary age (the Southern Outeniqua Basin) between the Agulhas Bank and a marginal fracture ridge to the south (Diaz Ridge). They argue that the latter is part of a combined fracture system also comprising the Agulhas Fracture Zone and the Falkland Escarpment marginal ridge of Lorenzo and Mutter [2]. They propose a tectonic model in which this structure "developed initially as a major 'intracontinental' transform fault", during rotation of the Lafonia microplate associated with the rifting of Gondwana, prior to Cretaceous opening of the South Atlantic Ocean. They further propose continuity of the fault system beneath the Falkland Plateau into South America. In their model, crustal extension associated with Middle–Late Jurassic rotation of the Lafonia microplate requires them to postulate "simultaneous westward escape of a Patagonian microplate . . . . . . . . . probably bounded by a right-lateral transtensional shear on its northern side".

It is not necessary merely to postulate such a Patagonian fault system, since there is clear evidence for its reality as the Gastre Fault System. Moreover, we have already interpreted this in the context of Gondwana rifting and many of the details of the model summarized above were also argued by us [3]. The Gastre Fault System [4] was recognized as a major dextral shear along the southwestern margin of the North Patagonian massif by Rapela et al. [5]. Evidence for the timing of its initiation is provided by genetic association with Early Jurassic igneous rocks of the Batholith of Central Patagonia [6], but it appears to have been still active during the eruption of Middle Jurassic rhyolites (e.g. Península Camarones, C.W. Rapela, unpublished observations). In our review, we traced evidence for the presence of this structure from the Pacific to the Atlantic coasts and showed that its trace was precisely continuous geometrically with that of the combined Agulhas–Falkland Fracture Zone. We proposed right-lateral movement along the whole length of this trace, starting with crustal

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rifting in Early Jurassic times. We pointed out that this movement may have been partly accommodated by crustal thinning but that the translation and rotation of the Malvinas/Falkland Islands block would have occurred at this time. We also suggested that this resulted in westward displacement of what we termed the Southern Patagonian Block (SPB) relative to cratonic South America north of the Gastre Fault System and relative to West Antarctica to the south of a hypothetical left-lateral shear. This is identical with the postulation of Ben-Avraham et al. We illustrated how correcting for such displacement can lead to a tighter reconstruction of pre-rift plate geometry, including obviation of the well-known 'overlap' between the Antarctic Peninsula and southern South America (see [1], fig. 10).

In discussing the causes of these early rifting kinematics, Ben-Avraham et al. suggest rapid roll-back of the trench axis of a subducting Pacific plate, leading to 'trench-suction forces' at the western margin of the continent, as the prime cause of break-up. This is also the scenario presented by Storey et al. [7] for the establishment of a broad extensional crustal zone throughout the South Atlantic–Antarctic Peninsula region. Such a regime may be identified from its magmatic signature. Throughout the length of the Antarctic Peninsula, Middle Jurassic magmatic products comprise parts of the Antarctic Peninsula Volcanic Group, including high magnesian andesites [8] and other volcanic rocks of back-arc origin [9] and rift-related anatectic granites [10]. However, the most dramatic example is undoubtedly in the vast silicic volcanic province of Patagonia (Chon-Aike, Tobífera, etc.). In our paper we argued from new Rb–Sr geochronological data (mostly unpublished at that time) that there was essential continuity of magmatism related to subduction at the Pacific margin of Patagonia during westward displacement, beginning with the 200 Ma granites associated with the fault system at Gastre [6], through the high-silica rhyolites of the Marifil complex in the east [11,12], to the 165–170 Ma rhyolite–ignimbrite volcanism of the Chon-Aike formation further south [13]. We relate the anomalous thermal regime associated with such intense magma formation in the lower crust [11,12], at least in part, to the fact that the stretched crust of the SPB may have overridden the subduction zone as it moved westwards — a situation distinct from the roll-back proposed by Ben-Avraham et al. Thus, we recognize this magmatic province as a consequence of the break-up process of Gondwana, rather than any aspect of its cause (for example, related to a plume).

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