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Reply

How not to build a supercontinent: A reply to J.D.A. Piper

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ABSTRACT

The hypothesized existence of a Neoproterozoic supercontinent called Rodinia is based on a series of geological and paleomagnetic observations, with details about the configuration and evolution of this supercontinent still a matter for debate. Regrettably, we found that the comment by Piper (this volume) lacks scientific objectiveness. The 'Palaeopangaea' that he promotes is, in our view, based on incorrect application of paleomagnetic data, and is not supported by geological evidence.

As pointed out in the introduction of Li et al. (2008), "although few still doubt the existence of a late Precambrian supercontinent, there is still no consensus regarding the number of participating cratons, their relative configuration within the supercontinent and the chronology and mode of assembly and break-up of the supercontinent". Healthy debates on alternative reconstructions based on sound scientific observations and approaches, and rational deductions, are thus most welcome in order to move the subject forward. Unfortunately, we found the comment by Piper (this volume) neither rational nor based on sound scientific observations and approaches. His comment, instead, starts with numerous unsubstantiated accusations, followed by another promotion of the 'Palaeopangaea' hypothesis which he first developed in 1970s through unconventional paleomagnetic approaches that lack the necessary scientific rigor, and based on geological arguments that are biased and outdated. Below we address major points raised in the comment following the order of their appearance.

1. Model-driven or evidence-driven

In a number of instances of the comment (first and third paragraphs), Piper accuses Li et al. (2008) of uncritical acceptance of the SWEAT hypothesis, of hiding controversies in Neoproterozoic paleogeography, and of ignoring new paleomagnetic and geological data. We reject these accusations outright, as they are untrue and are offensive to the larger Precambrian geoscience community, the 300-plus members of International Geoscience Programme (IGCP) Project 440 in particular.

Li et al. (2008) stated explicitly in the introduction, in the concluding remarks, and in the acknowledgments, that the issue of Rodinia reconstruction is highly controversial, and that the model presented in the paper is permissible but non-unique geologically and paleomagnetically at our current level of knowledge. A number of competing models were discussed, including the Laurentia–Siberia connection proposed by Sears and Price (1978, 2000) (see Fig. 2e of Li et al., 2008), and Appendix I illustrated two of the alternative Rodinia reconstructions. In the same volume, some of the co-authors presented alternative reconstructions. Piper's Palaeopangea reconstruction was cited in the introduction to the special issue but not discussed extensively by Li et al. (2008) because its numerous paleomagnetic and geological flaws (see below) have in part already been refuted (e.g., Van der Voo and Meert, 1991; Torsvik and Meert, 1995; Meert and Torsvik, 2004). Piper's continued insistence (2007 and this volume) on his nearly 40-year-old model (Piper et al., 1973) with only minor adjustments that do not address these quantitative refutations, requires us to restate them yet again.

Joining this reply is David Evans, who is publishing a radically different Rodinia reconstruction (Evans, 2009) bearing no resemblance to the SWEAT configuration of Moores (1991), Dalziel (1991) and Hoffman (1991). This further illustrates that we, as a group of scientists, are open to consider all possible paleogeographic scenarios, provided that they are based on credible paleomagnetic and/or geological arguments.

Piper also criticised the Li et al. (2008) model for it requires "*extraordinary and unlikely differential movements to achieve the Gondwana palaeogeography by early Phanerozoic times*". Apart from the documented potential ca. 800–750 Ma true polar wander events (Li et al., 2004; Maloof et al., 2006), the relative plate movements as in Fig. 9 and Appendix II of Li et al. (2008), ranging from the assembly of Rodinia until the ca. 530 Ma formation of Gondwanaland, are no more "*extraordinary*" or "*unlikely*" than accepted plate movements during the Phanerozoic.

2. 'Palaeopangaea' for ever?

Piper's Palaeopangaea supercontinent model (Piper, 1974, 1976; Piper et al., 1973) began with a comparison of global paleomagnetic data from 2200 to 1000 Ma, producing a reconstruction featuring a united Gondwanaland and Laurasian assembly with only minor adjustments relative to that within Pangea. At the time, this was a noble effort to bring together pioneering attempts of obtaining Precambrian paleomagnetic data into a kinematically simple structure.

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