Gondwana collision

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The formation, evolution and disruption of supercontinents has been the focus of several investigations in the recent years (e.g., Rogers and Santosh 2003; Nance et al. 2013). In particular, the assembly and breakup of supercontinents control Earth's geological evolution, including first order tectonic processes such as mountain building (Collins 2003; Dickinson 2004), seafloor spreading (Zhang et al. 2009; Murphy et al. 2009; Eriksson et al. 2009; Santosh et al. 2009), and mantle structure and dynamics (e.g. Anderson 1982; Su and Dziewonski 1997; van der Hilst et al. 1997; Gurnis et al. 1998; Ritsema et al. 1999; Masters et al. 2000; Grand 2002; Romanowicz and Gung 2002; Coltice et al. 2009; Ernst 2009).

Proposed supercontinents include Kenorland (ca. 2,650–2,450 Ma), although it appears more likely that there were several supercratons that stabilized at different times during the Mesoarchean into the Paleoproterozoic (Bleeker 2003), such as Vaalbara (ca. 3,400–2,800 Ma), Superia (ca. 2,800–2,400 Ma) and Sclavia (ca. 2,600–2,200 Ma). Thus, the first true supercontinent was Nuna/Columbia (ca. 1,900–1,500 Ma), followed by Rodinia (ca. 1,000–750 Ma), Gondwana (ca. 550–180 Ma) and Pangea (ca. 250–180 Ma). However, although evidence for supercontinent cycles in the past is strong, all supercontinents

older than Pangea (ca. 250 Ma) are conjectural in terms of their configuration and paleogeography (Reddy and Evans 2009). The processes responsible for supercontinent assembly are also controversial (Zhang et al. 2009). Some workers suggest that a supercontinent may be formed as a result of collision of randomly moving continents with no explicit involvement of the underlying mantle (Tao and Jarvis 2002). Others consider the formation of supercontinents as a consequence of mantle dynamics (Lowman and Jarvis 1995; Gurnis et al. 1998; Phillips and Bunge 2005, 2007).

The breakup of Rodinia and the assembly of Gondwana in the Neoproterozoic has attracted several studies, since this period marks an important turning point in Earth history with many global environmental changes and the first appearance of modern life (Maruyama and Santosh 2008; Meert 2012; Maruyama et al. 2013). Rodinia supposedly formed by ca. 1,000 Ma and broke apart in the interval 800–700 Ma (Meert and Torsvik 2003) - broadly synchronously with the beginning of the assembly of Gondwana (Meert 2003; Powell and Pisarevsky 2002; Boger et al. 2002; Meert 2001; Torsvik et al. 1996; Meert and Torsvik 2003). Meert (2001) suggested, on the basis of paleomagnetic data, that final Gondwana assembly did not occur until sometime in the interval 550–530 Ma. Gondwana was assembled as the result of several orogenies that sutured the various components. Globally, these orogenies are collectively known by the name of “Pan-African events” and their geological record is the traceable evidence of the tectonic processes that assembled the supercontinent Gondwana at this time. Thus, Gondwana was formed by closure of several major Neoproterozoic oceans (Kröner and Stern 2004) and suturing between continents along the Brasiliano, Pan-African, Adelaidean and Beardmore orogenies. The oceans that closed were the Mozambique Ocean between East Gondwana (Australia, Antarctica, southern India) and West Gondwana (Africa, South America), the Adamastor Ocean between Africa and South America, the Damara Ocean between the Kalahari and Congo cratons, and the

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Trans-Sahara Ocean between the West African Craton and a poorly known pre-Pan-African terrane in north-central Africa (Klerkx and Deutsch 1977; Toteu et al. 1990; Black and Liégeois 1993) variously known as the Nile or Sahara Meta-Craton. Because of the enormous geographic extent of these tectonic events the geochronological ages related to what is loosely referred to as the “Pan-African events” span an interval from 800 Ma to about 500 Ma. It is only recently that detailed studies allow discriminating individual tectonic events within the Pan-African (e.g. Johnson et al. 2011).

Despite a lot of progress in improving our knowledge of the assembly and break up of Gondwana over the past two decades, there are still many questions in need of answers. In order to answer some of these questions a symposium to discuss the amalgamation of Gondwana was organised at EGU in Vienna in April 2011. This special issue of *Mineralogy and Petrology* on “Gondwana Collision” is an outcome of this symposium. In this issue we are pleased to present thirteen contributions (Fig. 1) that contribute to an active discussion about how Gondwana was assembled.

The contribution by (1) Murphy et al. (2013) summarizes the early geodynamic history of peri-Gondwanan terranes

(e.g. Avalonia, Carolinia, Cadomia) along the northern margin of Gondwana. The metamorphic evolution and the cooling history of central Dronning Maud Land have been studied by (2) Elvevold and Engvik (2013) and (3) Hendriks et al. (2013), respectively. New geochronological data are presented by (4) Tenczer et al. (2013) from northern Tanzania to unravel the tectonometamorphic history of the Maasai Steppe and by (5) Balintoni and Balica (2013) to refine the provenance and the evolution of Pan-African terranes preserved in the South Carpathians of Romania. Petrogenesis of granulite formation based on petrography, geothermobarometry, and mineral equilibrium modeling from a new occurrence of incipient charnockite at Mavadi in the Trivandrum Granulite Block, southern India is discussed by (6) Endo et al. (2013). The significance of late Neoproterozoic magmatism is investigated by (7) Toummite et al. (2013) for the Anti-Atlas Belt and by (8) Sherif et al. (2013) for the northern part of the Arabian-Nubian Shield. (9) Lenz et al. (2013) present the first major and trace compositions, as well as Sm and Pb isotopic signatures from the Cerro Bori orthogneisses in the Dom Feliciano Belt. Ophiolitic rocks of the Arabian-Nubian Shield are studied by (10) Khedr and Arai (2013) and (11) Azer et al. (2013).

Fig. 1 Map of Gondwana showing the general arrangement of cratons, shields and oceans at the end of the Neoproterozoic. The red circles are approximate locations of the study areas in this issue. The inserted numbers are: (1) Murphy et al. 2013; (2) Elvevold and Engvik 2013;

(3) Hendriks et al. 2013; (4) Tenczer et al. 2013; (5) Balintoni and Balica 2013; (6) Endo et al. 2013; (7) Toummite et al. 2013; (8) Sherif et al. 2013; (9) Lenz et al. 2013; (10) Khedr and Arai 2013; (11) Azer et al. 2013; (12) Hamimi et al. 2013; (13) Nasipuri and Bhadra 2013

The tectonic history and the deformation events of Wadi Yiba area in southern Arabian Shield are investigated by (12) Hamimi et al. (2013). (13) Nasipuri and Bhadra (2013) discuss the tectonic evolution of the Bolangir belt-like anorthosite complex and the adjoining granulites from the Eastern Ghats Granulite Belt. The guest editors of the issue tried to choose contributions to cover the whole of Gondwana; however, to cover a supercontinent, many more contributions would have been required.

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