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GR Letter

# What's in a name? The Columbia (Paleopangaea/Nuna) supercontinent

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ABSTRACT

Supercontinents play an important role in Earth's history. The exact definition of what constitutes a supercontinent is difficult to establish. Here the argument is made, using *Pangæa* as a model, that any supercontinent should include ~75% of the preserved continental crust relevant to the time of maximum packing. As an example, *Rodinia* reached maximum packing at about 1.0 Ga and therefore should include 75% of all continental crust older than 1.0 Ga. In attempting to 'name' any supercontinent, there is a clear precedent for models that provide a name along with a testable reconstruction within a reasonable temporal framework. Both *Pangæa* and *Rodinia* are near universally accepted names for the late Paleozoic and Neoproterozoic supercontinent respectively; however, there is a recent push to change the Paleo-Mesoproterozoic supercontinent moniker from "*Columbia*" to "*Nuna*". A careful examination of the "*Nuna*" and "*Columbia*" proposals reveals that although the term "*Nuna*" was published prior to "*Columbia*", the "*Nuna*" proposal is a bit nebulous in terms of the constitution of the giant continent. Details of "*Nuna*" given in the original manuscript appear to be principally based on previously published connections between Laurentia, Baltica and, to a lesser extent the Angara craton of Siberia (*i.e.* "the lands bordering the northern oceans"). Therefore the proposal is made that "*Columbia*" consists of several core elements one of which is "*Nuna*".



## 1. Introduction

The recognition of continental drift by Wegener (1912) was of fundamental importance in the eventual acceptance of the plate tectonic revolution. One of the key concepts that helped Wegener document his case for continental drift was the idea of a large united landmass consisting of most of the Earth's continental regions. The late Paleozoic supercontinent of *Pangæa* (*cf.* Pangea, Wegener, 1915, 1922) stands alone as the most rigorously defined supercontinent in Earth history although arguments persist as to the exact relationships between the various elements of *Pangæa* (see discussion in Domeir et al., 2011). Wegener (1915) provided the first reconstruction for this supercontinent (Fig. 1) that he dubbed "*Urkontinent*" and subsequently (Wegener, 1922) referred to the supercontinent as "*diePangäa*" (the Pangea). Conversion of the German *Pangäa* to a proper English noun results in a more correct spelling of *Pangæa* (Rance, 2007).

A supercontinent can be simply defined as a quasi-rigid or rigid assembly of most of the Earth's continental landmasses (Hoffman, 1999; Rogers and Santosh, 2004). Defining what constitutes 'most' of the Earth's continental crust is problematic (see Bradley, 2011), but the size of *Pangæa* can serve as basis for comparison as it consisted of between 75 and 90% of the Earth's continental crust. There are of course problems with defining a simple metric for establishing what does/does not constitute a supercontinent, especially in the Precambrian even using the 'proxy approach' advocated by Bradley (2011).Although it is not critical to the argument presented in this paper, a proposition that 75% of the Earth's preserved crust (of the relevant age) should be present in any reconstructed supercontinent seems reasonable (for example 75% of Archean nuclei should be part of any Archean supercontinent).

## 2. Supercontinents in Earth history

Early hints that older supercontinents existed prior to *Pangæa* were based on 'common' isotopic ages observed in various places around the globe (Gastil, 1960; Runcorn, 1962; Sutton, 1963). Runcorn (1962) proposed 4 phases of 'orogenesis' at 200 Ma, 1000 Ma, 1800 Ma and 2600 Ma. Sutton (1963) suggested seven orogenic cycles of 200–400 Ma duration. Remarkably, a recent compilation by Campbell and Allen (2008) of U–Pb detrital zircon ages almost precisely mimics the four phases of orogenesis advocated by Runcorn (1962; Fig. 2). In the early to mid-1970s, on the basis of geologic, paleontologic and paleomagnetic data, researchers began to posit the existence and outline possible reconstructions for an older supercontinent that formed around 1.1–1.0 Ga and broke apart during the late Neoproterozoic (Valentine and Moores, 1970, 1972; Burke and Dewey, 1973; Irving et al., 1974; Piper, 1976; Sawkins, 1976). The initial name for this supercontinent was given by Valentine and Moores (1970) as *Pangea-I* and later Sawkins (1976) referred to the supercontinent as "*proto-Pangea*" although no reconstructions were provided in either paper. Piper (1976) referred to his reconstruction as simply "The Late Proterozoic supercontinent"

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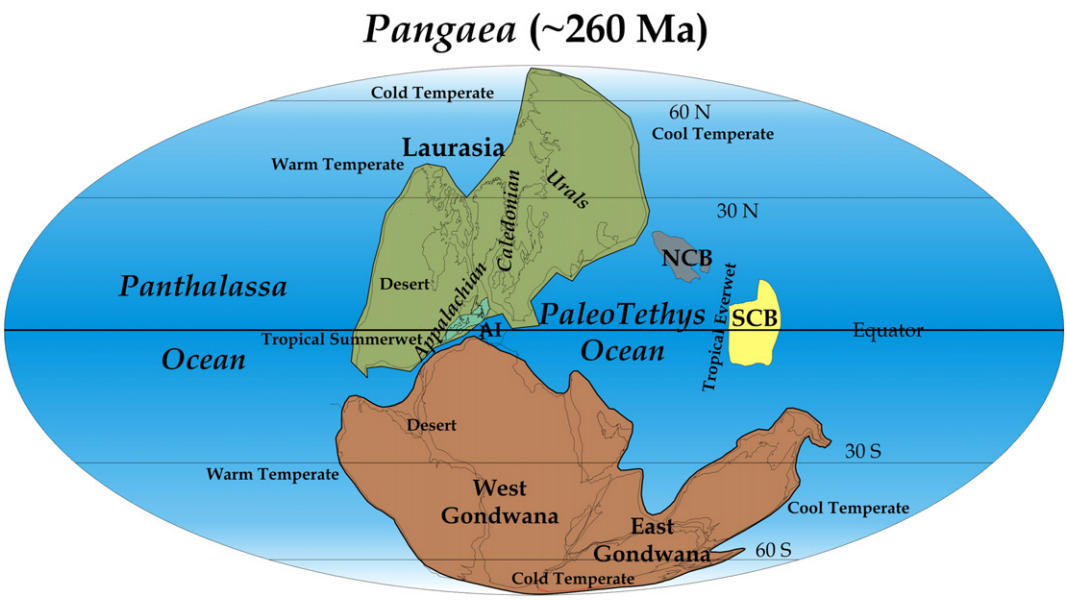


**Fig. 1.** The supercontinent *Pangæa* during the Late Paleozoic (~260 Ma). The supercontinent was composed of two large halves (Gondwana in the south and Laurasia in the north). The 'pac-man' shaped PaleoTethys ocean was located to the west of the supercontinent and separated from the larger Panthalassan ocean by the North China (NCB) and South China (SCB) blocks. Approximate locations of the strong zonal climatic zones are also shown in the figure. The locations of the Appalachian, Caledonian and Uralian Mountains are shown within Laurasia. AI = Armorica, Avalonia and Iberia.

although he later refers to the Neoproterozoic supercontinent as "*Paleopangaea*" (Piper, 2000, 2007). Bond et al. (1984) also noted that there were significant tracts of rifted margins surrounding Laurentia and proposed a reconstruction for the Neoproterozoic supercontinent, but did not give it a name.

The first to provide a name (*Rodinia*), a temporal framework (Neoproterozoic) and a reconstruction for the supercontinent were McMenamin and McMenamin (1990; Fig. 3). The reconstruction provided by McMenamin and McMenamin (1990) was based on earlier reconstructions of McMenamin (1982), Piper (1987), Donovan (1987) and Sears and Price (1978). The name *Rodinia* is derived from the Russian infinitive "*rodit*" that means 'to beget' or 'to grow' and was chosen because it was then thought that *Rodinia* gave birth to all subsequent continents and its edges served as loci for the development of complex animals (McMenamin and McMenamin, 1990). Although several seminal papers on the Late Neoproterozoic supercontinent were published in the early 1990s none specifically referred to the supercontinent as *Rodinia* (Dalziel, 1991; Hoffman, 1991; Moores, 1991; Dalziel, 1992). In 1993, two papers appeared in the peer-reviewed literature referring to the Neoproterozoic supercontinent as *Rodinia* (Powell et al., 1993a,b). Since that time, the name *Rodinia* is the dominant name used to refer to a wide variety of Neoproterozoic supercontinental reconstructions (see also Torsvik et al., 1996; Weil et al., 1998; Meert and Torsvik, 2003; Li et al., 2008).

During the late 1980s, Paul Hoffman suggested that the 1.8–1.6 Ga amalgamation of the cratonic elements of Laurentia may have occurred contemporaneously with the formation of an even larger supercontinent (Hoffman, 1988, 1989a,b). Global reconstructions for this hypothetical supercontinent were not shown in those publications although the time frame of its assembly was detailed. Gower et al. (1990) argued for a tight reconstruction of cratonic northern Europe against North America that they called *Nena*. Williams et al. (1991) gave a list of "fictitious" supercontinental names for use in describing the origin of cratonic elements of Laurentia. Three of these fictitious supercontinents can be temporally linked to the 1.8–1.6 Ga interval and include "*Hudsonland*" (1.9–1.8 Ga), "*Central Plainsland*" (1.7 Ga) and "*Labradorland*" (a.k.a *Mazatzaland* at 1.6 Ga). No reconstructions

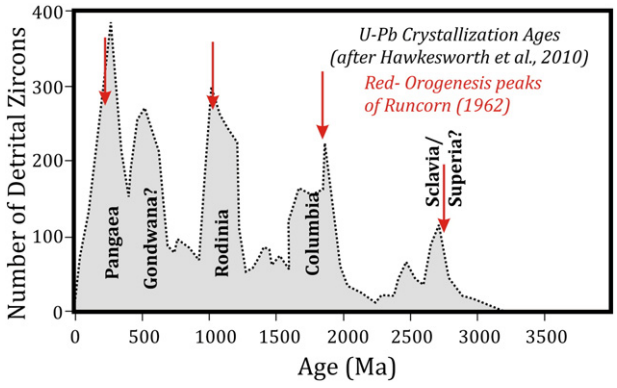


**Fig. 2.** Detrital zircon spectra as given in Hawkesworth et al. (2010) in comparison with those in Runcorn (1962). The key supercontinents apparent in the spectra include *Columbia*, *Rodinia* and *Pangæa*. Other peaks may reflect an earlier amalgam of Archean nuclei and *Gondwana*/*Ur-Gondwanaland*/*Pannotia* in the latest Neoproterozoic.

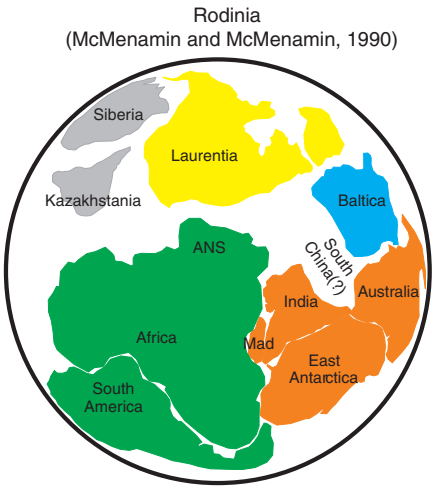


**Fig. 3.** Rodinia according to McMenamin and McMenamin (1990). The reconstruction is based on a Siberia fit proposed by Sears and Price (1978) with Kazakhstania positioned off present-day SW Laurentia. Baltica is fit close to Bullard et al. (1965) and just north of Australia. Gondwana was treated as a single landmass.