Journal of Asian Earth Sciences 94 (2014) 105–112

Contents lists available at ScienceDirect

Journal of Asian Earth Sciences

journal homepage: www.elsevier.com/locate/jseaes

The age of undeformed dacite intrusions within the Kolaka Fault zone, SE Sulawesi, Indonesia

Lloyd T. White [a,*], Robert Hall [a], Richard A. Armstrong [b]

[a] Southeast Asia Research Group, Department of Earth Sciences, Royal Holloway University of London, Egham, Surrey TW20 0EX, United Kingdom
[b] Research School of Earth Sciences, The Australian National University, Canberra 0200, Australia

ARTICLE INFO

Article history:
Received 26 February 2014
Received in revised form 5 August 2014
Accepted 9 August 2014
Available online 22 August 2014

Keywords:
Sulawesi
Kolaka
SHRIMP
Geochronology
Structure
Geochemistry

ABSTRACT

We present petrologic, geochemical and U–Pb sensitive high resolution ion microprobe (SHRIMP) data from previously undocumented dacite intrusions from the SE Arm of Sulawesi. The dacites occur in a strand of a major fault (the Kolaka Fault) that crosses the SE Arm of Sulawesi and northern Bone Bay. U–Pb SHRIMP dating shows the "Kolaka Dacite" yields zircon grains and overgrowths that range between ca. 4 and 7 Ma, indicating active magmatism in SE Sulawesi at this time. The youngest age population (4.4 ± 0.2 Ma) from this range is interpreted to be the maximum crystallization age for the dacite. The Kolaka Dacite is undeformed, and so potentially intruded during or after movement within a strand of the Kolaka Fault. The dacites may have otherwise been emplaced passively along existing foliation planes in the country rock schist. Additional U–Pb data were collected from inherited zircons, yielding ages between 8 Ma and 1854 Ma. We consider that these inherited zircons are xenocrysts, derived from either (1) a partially melted protolith and/or (2) xenocrysts assimilated during ascent of the magma. In either case, the inherited zircons record the age of the basement rocks beneath this part of SE Sulawesi. These inherited zircon cores show that the SE arm of Sulawesi is underlain by Proterozoic or younger material, validating earlier ideas that the crust here was derived from Gondwana.

1. Introduction

Sulawesi represents a region of collision, where west Sulawesi (a rifted margin of Sundaland), the Sula Spur (Australian margin) and Sulawesi's North Arm (volcanic arc) collided during the Late Oligocene-Early Miocene (e.g. Audley-Charles, 1974; Hamilton, 1979; Sukamto and Simandjuntak, 1983; Hall, 1996, 2002, 2012). This collision, and subsequent phases of crustal extension and strike-slip faulting led to the island's distinctive K-shape. The arms of the island are commonly divided into the: (1) North Sulawesi Volcanic Province (volcanic arc rocks), (2) Western Sulawesi Province (arc rocks and continental basement), (3) Central Sulawesi Metamorphic Belt, (4) East Sulawesi Ophiolite, and (5) other micro-continental fragments (East Arm and Buton) (Parkinson, 1998a; Elburg et al., 2003; van Leeuwen et al., 2007; Cottam et al., 2011) (Fig. 1). All of these terranes are cut by major strike-slip faults (e.g. the Walanae Fault System (van Leeuwen, 1981; Sukamto, 1982; Berry and Grady, 1987; Jaya and Nishikawa, 2013), the Gorontalo Fault (Katili, 1978), the Matano Fault (Hamilton, 1979; Silver et al., 1983a, 1983b), the Palu-Koro Fault (Katili, 1970; Hamilton, 1979; Silver et al., 1983a, 1983b), the Lawanopo Fault (Hamilton, 1979), and the Kolaka Fault (Simandjuntak and Surono, 1984; Surono, 1994) (Fig. 1). In this paper, we focus on the geology of the SE Arm of Sulawesi and report field relationships, petrology, geochemistry and geochronology data from a previously undocumented dacite intrusion found within a strand of the Kolaka Fault zone.

1.1. The southeast arm

Much of the SE Arm of Sulawesi is unpopulated, mountainous and heavily forested, meaning that very little geological work has been undertaken in the area. From the mapping that has been conducted, we know that the SE Arm is dominated by low to high-grade schists, as well as ultramafic and sedimentary rocks (Hamilton, 1979; Rusmana et al., 1993; Simandjuntak and Surono, 1984, 1994; Surono, 1994) (Fig. 2). The schists have been interpreted as part of the basement and were originally considered to have a Palaeozoic age (Surono, 1994). This age was assigned because the schists are cross-cut by aplites that were considered to have been intruded during the Permian or Carboniferous (Surono, 1994, 1998). However, the reason that the aplites were assigned Permian to Carboniferous ages is not documented. Given

* Corresponding author.

http://dx.doi.org/10.1016/j.jseaes.2014.08.014
1367-9120/

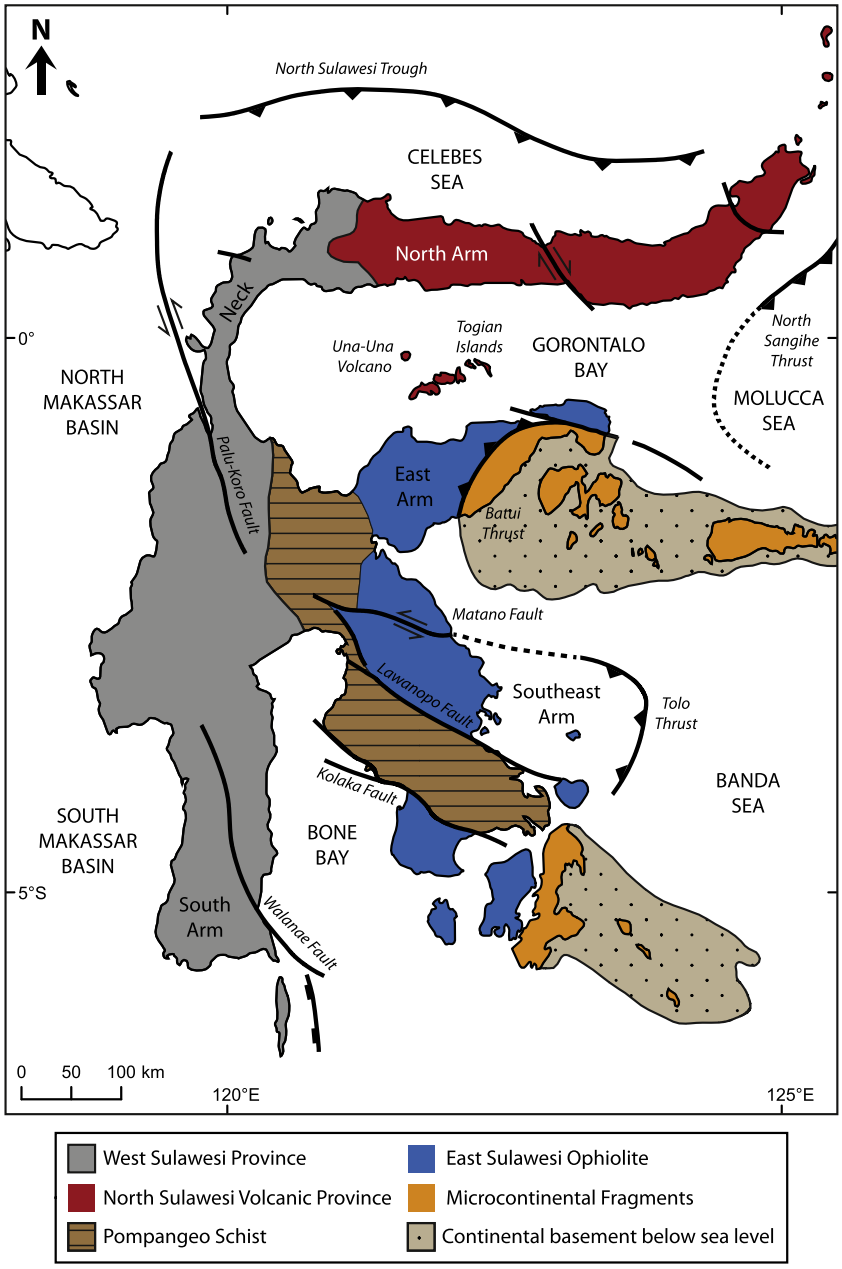

Fig. 1. Map showing the location of major faults and geological terranes of Sulawesi. The focus of this study is on dacites found within a strand of the Kolaka Fault zone (modified after Cottam et al., 2011).

the absence of age constraints on the cross-cutting aplites, it is equally likely that the schists of the SE Arm are related to either the Early Cretaceous Pompangeo Schist of Central Sulawesi Province (Parkinson, 1998b), or the schists of the Bantimala Metamorphic Complex (Wakita et al., 1996). They could also be related to none of these; a Cenozoic age is feasible.

In the SE Arm, Triassic sediments are unconformably overlain by Jurassic to Cretaceous carbonates (Tetambaha Formation), Eocene shallow marine carbonates (Tampakura, Lerea and Tamborasi formations) and Oligocene deposits of melange (Surono, 1994). All of these units have faulted contacts with ultramafic rocks which are rightly or wrongly considered to be part of the East Sulawesi Ophiolite. These rocks are unconformably overlain by the Neogene Celebes Molasse and recent alluvium (Hamilton, 1979; Silver et al., 1983b; Surono, 1994).

The SE Arm of Sulawesi is cross-cut by two major strike-slip fault systems. The northern-most fault is referred to as the Lawanopo Fault System, and the southern-most fault is named the Kolaka Fault (Hamilton, 1979; Simandjuntak and Surono, 1984, 1994; Surono, 1994) (Fig. 1). These faults are identified on aerial and satellite imagery as straight, northwest trending features (e.g. coastlines and cliffs). However, as the strike of these faults is parallel to the regional structural grain, their offset is uncertain (Hamilton, 1979), but are commonly interpreted to have a sinistral sense of movement, most likely because of the apparent offset of parts of the SE Arm. Both of these faults are considered to extend from onshore the SE Arm of Sulawesi into Bone Bay. Wide fault zones are observed in reflection seismic data along strike from the fault zones on land (Camplin and Hall, 2013, 2014). These faults are considered to have been active during the Plio-Pleistocene