

# Euoplanet TNA Report

## PROJECT LEADER

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## COLLABORATORS

<b>Name:</b>	<b>Affiliation:</b>
Frances M. Deegan	Earth Sciences, Uppsala University, Sweden (now at Swedish Museum of Natural History, Stockholm, Sweden).
Ester M. Jolis	Earth Sciences, Uppsala University, Sweden.
Jane P. Chadwick	(Formerly of) Petrology, Vrije Universiteit Amsterdam (VUA), the Netherlands.
<b>Date of TNA visit:</b>	1) 3 <sup>rd</sup> May to 25 <sup>th</sup> May, 2011. 2) 29 <sup>th</sup> May to 17 <sup>th</sup> June, 2011 3) 7 <sup>th</sup> Nov to 11 <sup>th</sup> Nov, 2011
<b>No. of days:</b>	Number of days in the lab: 35
<b>Host laboratory:</b>	VUA Isotope Geochemistry Facility.
<b>Reimbursed</b>	Yes.

## Project Title

### **Constraining the role of magma-crust interaction along the Sunda arc, Indonesia**

#### **Scientific Report Summary.**

*(plain text, no figures, maximum 250 words, to be included in database)*

Arc magmas typically display chemical and petrographic characteristics indicative of crustal input. Crustal contamination can take place either in the mantle source region or as magma traverses the upper crust. While source contamination is generally considered the dominant process, late-stage crustal contamination has been recognised at volcanic arcs too. We completed a detailed geochemical study of 7 volcanoes along a traverse from Anak-Krakatau in the Sunda strait through Java (Gede, Slamet, Merapi, Kelut, Kawah-Ijen) and Bali (Batur), to characterise the impact of the overlying crust on arc magma composition. Using rock and mineral elemental geochemistry and radiogenic isotopes of Sr, Nd and Pb (analysed with the support of Europlanet at the VUA) we show a correlation between upper crustal composition and the degree of upper crustal contamination. We find an increase in  $^{87}\text{Sr}/^{86}\text{Sr}$  and a decrease in  $^{143}\text{Nd}/^{144}\text{Nd}$  values from Krakatau towards Merapi, indicating substantial crustal input from the thick quasi-continental basement beneath East and Central Java. Volcanoes to the east of Merapi, and the Progo-Muria fault zone, where the upper crust is thinner and increasingly oceanic in nature, in turn, show considerably less crustal input in their isotopic signatures, indicating a stronger influence of the mantle source. Our new data represent a systematic and high-resolution arc-wide sampling effort that allows us to distinguish the effects of the upper crust on the compositional spectrum of individual volcanic systems along the Sunda arc. (232 words)

## Full Scientific Report on the outcome of your TNA visit

**Approx. 1 page**

### **Lab visits:**

Deegan completed three lab visits to VUA, Netherlands on the following dates: i) 3rd May to 25<sup>th</sup> May (Duration of stay: 23 days); ii) 29th May to 17th June (Duration of stay: 20 days); and iii) 7<sup>th</sup> November to 11<sup>th</sup> November 2011 (Duration of stay: 6 days). Travel for two of these visits was reimbursed by the VU, while travel for one trip was paid by Uppsala University. Total number of days spent in the laboratory: 35.

We initially planned ca. 6 weeks of lab time (i.e. 30 working days), however, we needed to exceed this estimate by one week in order to complete analysis.

### **Samples analysed:**

During the lab visits to the VUA isotope facility, Deegan undertook the following:

- i) Acid digestion of 12 bulk rock lava samples and 14 mineral separates (clean lab)
- ii) Chemical separation of Sr, Nd, and Pb from all samples (clean lab)
- iii) Preparation of measuring solutions for trace element analysis in the mineral separates by ICP-MS (clean lab)
- iv) Filament preparation and sample loading for Sr isotope analysis by TIMS (TIMS lab)
- v) Sr isotope measurements by TIMS (TIMS lab)
- vi) Preparation of measuring solutions for Nd and Pb isotope analysis by MC-ICP-MS (clean lab)

### **Outcomes:**

The outcome of the TNA visits is a large dataset of trace element, rare earth element, and Sr, Nd, and Pb isotope ratios of 26 samples from seven volcanoes along the Java segment of the Sunda arc, Indonesia.

The data are all high quality and are currently being processed for publication. The data are used to i) establish Sr-Nd-Pb isotopic systematics along the arc, ii) identify crustal contamination “peaks”, and iii) quantify the degree of crustal contamination using a combination of binary mixing and assimilation and fractional crystallisation models.

We find an increase in  $^{87}\text{Sr}/^{86}\text{Sr}$  (Fig. 1) and a decrease in  $^{143}\text{Nd}/^{144}\text{Nd}$  values from Krakatau towards Merapi, indicating substantial crustal input from the thick quasi-continental basement beneath East and Central Java. Volcanoes to the east of Merapi, and the Progo-Muria fault zone, where the upper crust is thinner and increasingly oceanic in nature, in turn, show considerably less crustal input in their isotopic signatures, indicating a stronger influence of the mantle source. Our new data represent a systematic and high-resolution arc-wide sampling effort that allows us to distinguish the effects of the upper crust on the compositional spectrum of individual volcanic systems along the Sunda arc.

An overview of the project and the first results were presented by Deegan in a seminar at the VUA in November 2011. The data have subsequently been presented at two international conferences by Jolis and team as listed below. A manuscript is currently in preparation for submission to a high ranking journal in the field of Earth Science.

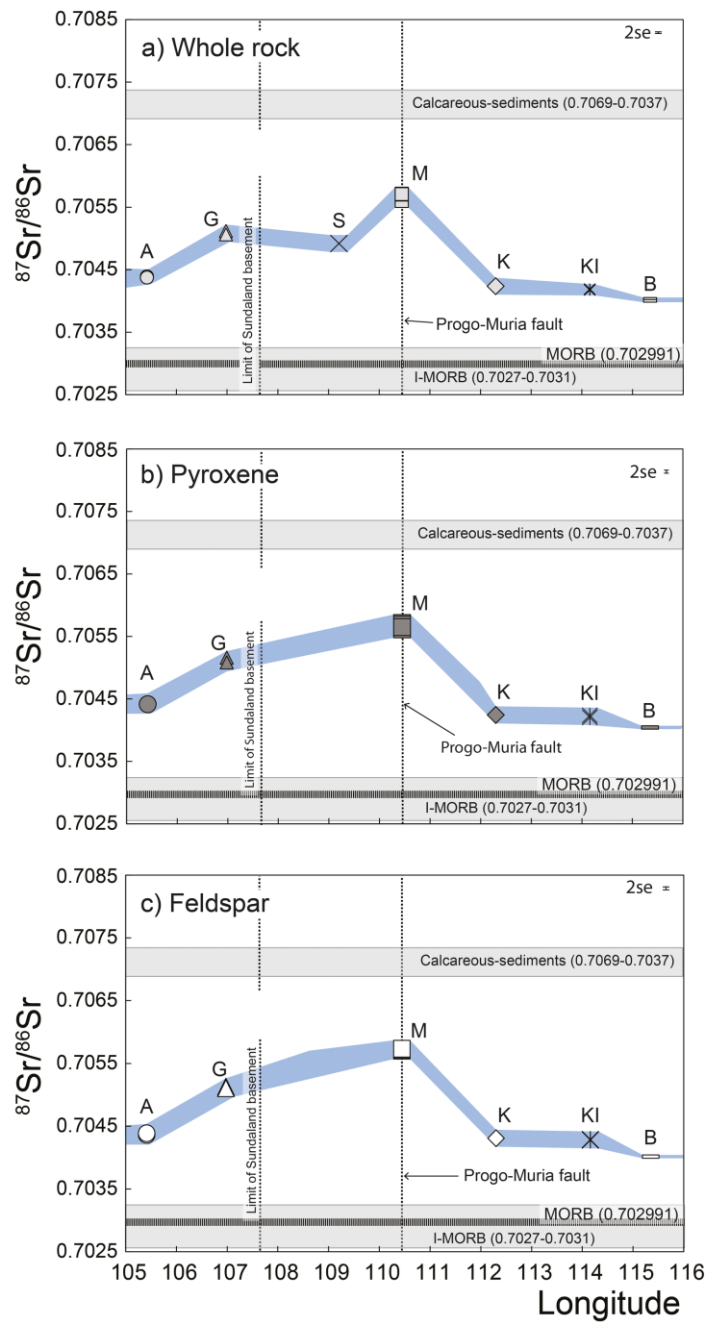


Figure 1:  $^{87}\text{Sr}/^{86}\text{Sr}$  results from seven volcanoes along a traverse from Anak-Krakatau in the Sunda strait through Java (Gede, Slamet, Merapi, Kelut, Kawah-Ijen) and Bali (Batur). Data for (a) whole rock samples, (b) pyroxene, and (c) feldspar mineral separates are shown. Note the increase in  $^{87}\text{Sr}/^{86}\text{Sr}$  from Krakatau towards Merapi, indicating substantial crustal input from the thick quasi-continental basement beneath East and Central Java in contrast to the eastern volcanoes which show a greater mantle influence.

## Publications arising/planned (include conference abstracts etc)

Jolis, E.M., Troll, V.R., Deegan, F.M., Blythe, L.S., Harris, C., Barker, A.K., Freda, C., Hilton, D., Chadwick, J.P., van Helden, M. Tracing crustal contamination along the Java segment of Sunda Arc, Indonesia. For submission to *Journal of Petrology*.

Jolis, E.M., Troll, V.R., Deegan, F.M., Blythe, L.S., Harris, C., Freda, C., Hilton, D., Chadwick, J.P., van Helden, M. (2012). Tracing crustal contamination along the Java segment of Sunda Arc, Indonesia. Abstract volume, Goldschmidt Conference 2012, Montreal, Canada.

Jolis, E.M., Troll, V.R., Deegan, F.M., Blythe, L.S., Harris, C., Freda, C., Hilton, D., Chadwick, J.P., van Helden, M. (2012). Tracing crustal contamination along the Java segment of Sunda Arc, Indonesia. Abstract volume, European Geosciences Union 2012, Vienna, Austria.

## Host approval

The host is required to approve the report agreeing it is an accurate account of the research performed.