

GERMANY/HONG KONG JOINT RESEARCH SCHEME
THE PROJECT REPORT
(for Project Completion)

Project Number: G_HK033/12

Title

Investigation of Nd-Hf isotopic decoupling: case studies of West Junggar and South China granitoids

Particulars

	Hong Kong team				German team	
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	<input type="checkbox"/>	HKBU	<input type="checkbox"/>	LU	<input type="checkbox"/>	Others: _____
	<input type="checkbox"/>	HKIED	<input type="checkbox"/>	PolyU		
Other project team members (if any)	Dr Hongyan Geng					

Funding Period

	1 st year	2 nd year (if applicable)
Start Date	1.1.2013	1.1.2014
Completion Date	31.12.2013	31.12.2014

Objective(s) as per original application

1. to select representative granitoids from the West Junggar and South China as examples for whole-rock Sm-Nd and Hf-in-zircon isotopic decoupling and non-decoupling.
2. to investigate the source materials of the granitoids and their effect on the whole rock Sm-Nd and zircon Lu-Hf isotopic systems.
3. to investigate the effects of secondary processes (weathering, alteration, and metamorphism) on the Sm-Nd whole rock and zircon Hf isotopic systems.
4. to understand the behavior of the two isotopic systems in granite petrogenesis and to shed light on the geologically meaningful interpretation of the two isotopic systems.

Details of Report [Please attach relevant document(s)]

i) Outline of proposed research and results obtained

We selected representative samples of granitoids from the West Junggar, Chinese Altai and South China. The samples have been analyzed for whole-rock Sm-Nd isotopic compositions. Zircon minerals were separated from these samples and analyzed for their U-Pb ages and Hf isotopic compositions. Clear decoupling between Hf-in-zircon and whole rock Nd isotopic systems are confirmed for our samples.

The magmatic source materials of the granitoids are carefully studied using major and trace element compositions. The granitic intrusions in South China are mostly S-type, implying partial melting of sedimentary rocks. The granitic plutons in West Junggar are dominantly alkali-rich granitoids, implying anorogenic process. Some of them are adakitic, possibly derived from partial melting of subducted oceanic slab. The granitic rocks in the Chinese Altai are more diverse, including I-, S- and A-type granites (Fig. 1).

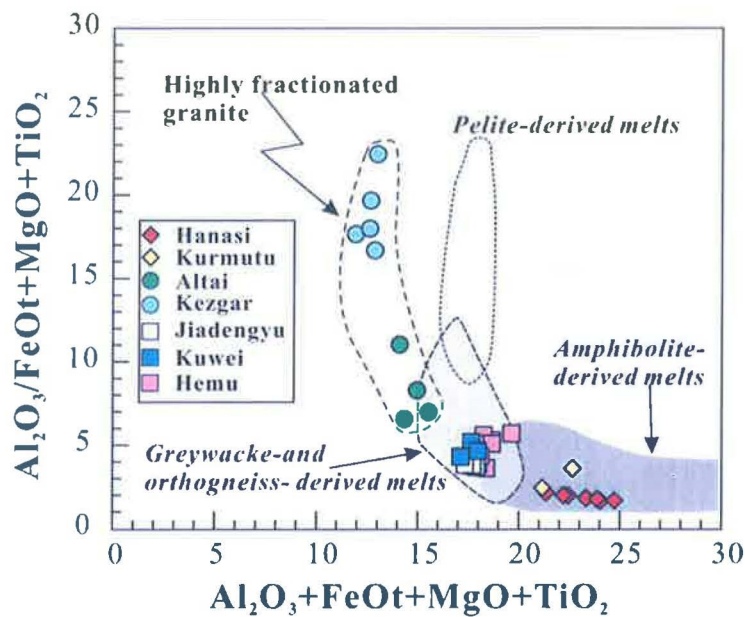


Fig. 1. (a) Binary plot $Al_2O_3 + FeO_t + MgO + TiO_2$ vs. $Al_2O_3/(FeO_t + MgO + TiO_2)$ for the studied samples; outlined are domains occupied by experimental granitic melts obtained by partial melting of metapelites, metagreywackes and amphibolites (Janoušek et al., 2010 and references therein).

Based on the above petrogenetic understanding, samples from the West Junggar and Chinese Altai are used for more detailed study, because these samples represent more diverse origin and can decipher complicated geodynamic processes. Our results show Hf-Nd isotopic decoupling for all these types of granitoids, regardless of their petrogenetic origin (Fig. 2).

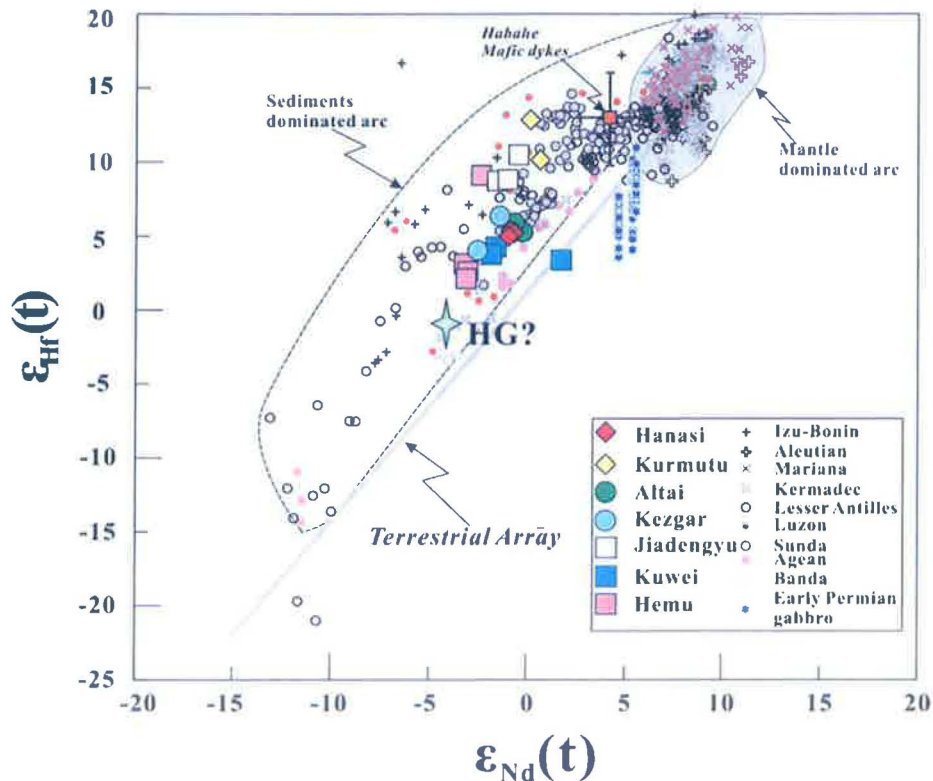


Fig. 2. Initial $\epsilon_{Nd}(t)$ vs. initial $\epsilon_{Hf}(t)$. Terrestrial Array is from Vervoort et al (2011), $\epsilon_{Hf} = 1.55 * \epsilon_{Nd} + 1.21$. The data of mafic dykes is from Cai et al (2010) and Habahe group (HG) data are from Long et al (2007, 2010) and Jiang et al (2011). The data of early Permian gabbro of the Chinese Altai is from Zhang et al., (2014). Data were compiled using the Georoc database (<http://georoc.mpch-mainz.gwdg.de/georoc/>) for IAV.

In order to investigate the effects of secondary processes (weathering, alteration, and metamorphism) on the Sm-Nd whole rock and zircon Hf isotopic systems, we carried out whole rock Hf isotopic analysis. This work demonstrates Nd-Hf isotopic decoupling for whole rock systems as well as whole rock-zircon systems.

ii) Significance of research results

We carefully tested several possibilities causing the Nd–Hf isotopic decoupling, including zircon effects in a magma source dominated with sedimentary materials, garnet effect in a deep depth with garnet as residual phase in magma genesis. The high $\epsilon_{Hf}(t)$ values and poor correlation between $\epsilon_{Hf}(t)$ and $\epsilon_{Nd}(t)$ values demonstrate that the Chinese Altai arc was not Andean-type continental arc but may be built on the juvenile continent. We thus propose that the West Junggar and Chinese Altai represent two separate arc systems in the Paleozoic. When an arc is located near a continent, sediments consisting of large amount of old continental materials can be subducted. Then the selective enrichment of Nd can affect Nd isotopic budget of the mantle and result in low $\epsilon_{Nd}(t)$ values in the mantle wedge, such as modern Sunda arc and Lesser Antilles where the $\epsilon_{Nd}(t)$ values can be as low as -10 (Fig. 2). This understanding is very important for our understanding of isotopic decoupling in modern, especially old solid earth systems, which enable us to know how to correctly use Nd and Hf isotopic data to solve petrogenetic and geodynamic problems.

iii) Research output

The data and results are presented in a manuscript, which will be submitted to Chemical Geology, entitled of “Decoupling between Nd-Hf isotopic systems in Chinese Altai and its tectonic implications”, coauthored by Y Yu, M Sun, C Yuan, X Long, A Kroener et al.

In the course of this project, the following co-authored papers were published:

Kröner, A., Kovach, V., Belousova, E., Hegner, E., Armstrong, R., Dolgoplova, A., Seltmann, R., Alexeiev, D.V., Hoffmann, J.E., Wong, J., Sun, M., Cai, K., Wang, T., Tong, Y., Wilde, S.A., Degtyarev, K.E., Rytisk, E., 2014. Reassessment of continental growth during the accretionary history of the Central Asian Orogenic Belt. *Gondwana Research* 25, 103-125.

Geng H., Brandl G., Sun M., Wong J., Kröner A., 2014. Zircon ages defining deposition of the Palaeoproterozoic Soutpansberg Group and further evidence for Eoarchaean crust in South Africa, *Precambrian Research*, 249, 247-262.

Kröner, A., Santosh, M., Hegner, E., Shaji, E., Geng, H., Wong, J., Xie, H., Wan, Y., Shang, C.K., Liu, D., Sun, M., Nanda-Kumar, V., 2015. Palaeoproterozoic ancestry of Pan-African high-grade granitoids in southernmost India: Implications for Gondwana reconstructions. *Gondwana Research* 27, 1-37.

Kröner, A., Kovach, V.P., Kozakov, I.K., Kimozova, T., Azimov, P., Wong, J., Geng, H.Y., 2015. Zircon ages and Nd–Hf isotopes in UHT granulites of the Ider Complex: A cratonic terrane within the Central Asian Orogenic Belt in NW Mongolia. *Gondwana Research* 27, 1392-1406.

iv) Potential for or impact on further research collaboration

This project strengthens collaboration between Hong Kong and German researchers. We will continue scientific collaboration on isotopic studies and Central Asian Orogenic research.