RGC Ref.: M-HKU706/13
(please insert ref. above)

The Research Grants Council of Hong Kong
SRFDP & RGC ERG Joint Research Scheme
Completion Report

(Please attach a copy of the completion report submitted to the Ministry of Education by the Mainland researcher)

Part A: The Project and Investigator(s)

1. Project Title

Magmatic conduit system of the Jinchuan Cu-Ni-(PGE) sulfide deposit (NW China) with implication for exploration

2. Investigator(s) and Academic Department/Units Involved

	Hong Kong Team	Mainland Team
Name of Principal Investigator *(with title)*	M.F. Zhou	S. Su
Post	Professor	Professor
Unit / Department / Institution	Earth Sciences	School of Earth Sciences and Resources/China University of Geosciences, Beijing
Contact Information	2857 8251 mfzhou@hku.hk	susg@cugb.edu.cn
Co-investigator(s) *(with title and Institution)*		
PhD student(s) (with period of involvement)	Name: Pingping Liu, PengFei Zhang Institution: HKU Period from 2011 to 2017	

Note: The Hong Kong project team must involve at least one research postgraduate student pursuing a Doctor of Philosophy degree at the UGC-funded university (PhD student) at any time throughout the project period.

3. Project Duration

	Original	Revised	Date of RGC/ Institution Approval *(must be quoted)*

Project Start date	January 1, 2014		December 20, 2013
Project Completion date	31/12/2016		
Duration *(in month)*	36 months		
Deadline for Submission of Completion Report	31/12/2017		

Part B: The Completion Report

5. Project Objectives

5.1 Objectives as per original application

1. To constrain the origin and evolution of ore-related mafic magma.
2. To identify textures and structures in relation to the flow direction of magma conduits.
3. To generate 3-dimentional maps for the distributions of ore bodies and
4. To propose an exploration model for guiding exploration of new mineral resource in Jinchuan and elsewhere.
....

5.2 Revised Objectives

Date of approval from the RGC: _____

Reasons for the change: _____

6. Research Outcome

Major findings and research outcome
(maximum 1 page; please make reference to Part C where necessary)

Three of our original objectives set in our original proposal are reached, but one of the objectives was not possible because of the shortage of funds. Our activities related to the project have been productive. As expected, there were no major problems during the project period. The project was in fact a continuation of several previous studies of our researches bot at HKU and CUGB but aimed at different problems with significant implications.

Major findings.

(1) Origin and evolution of the mafic magmas:
To study the origin and evolution of magmas, we have investigated the mineralogy and petrology of ore-related intrusions and analyzed their major element contents and Re-Os isotopic compositions. According to available petrograpic and geochemical data, we used a software, pmelts, to model the composition and formation depth of the primary melts. We found that the primary melts was high $Mg^{\#}$ dioritie magma, generated at <3 GPa.

(2) Structural and textural evidence for fluid flow of the Jinchuan system:
To explore the flow direction of magma conduit, we have conducted very detailed mapping in the Jinchuan deposit, with particular attention paid on the geometry and ore grade of orebodies. In addition, crystal size distributions, Cu/Ni ratios and PGE contents of ores are investigated. Our studies demonstrate that the metal-bearing magma flowed from northwest to southeast. We also made detailed observations on the hydrothermal minerals. We found convinced evidence for fluid flow, and further found that the intensity of fluid activity increased from east to west.

(3) Model for exploration in Jinchuan:
In the Jinchuan Cu-Ni (PGE) deposit, no large ore bodies were discovered in the deep level. Our study determined the flow direction of metal-bearing magma and relative formation sequence of different orebodies, providing useful guidance for ore exploration in the future.

Research outcome
This project was successful with important findings published in a highly ranked journal Lithos (IF-impact fact =>3).

Potential for further development of the research and the proposed course of action *(maximum half a page)*

Zhou, Su and their research groups have been working on the sulfide mineral deposits associated with magmatic intrusions in China and have made some major achievements in the understanding of their origin. The remaining problems are identified for further studies and include better constraints on the physical property of primary melts. To do this, more experimental investigation is needed. To better understand the formation of the sulfide deposits in China will also require the comparison with the deposits elsewhere in the world. We anticipate to eventually establish a new style of magmatic sulfide deposits. Overall, our previous work on these sulfide deposits of this project has made a major impact internationally and the geological features are now well known in the world. In the future, Zhou, Su and their research groups will collaborate with oversea colleagues to continue their studies on the well know sulfide deposits.

7. The Layman's Summary

(describe in layman's language the nature, significance and value of the research project, in no more than 200 words)

Mafic-ultramafic intrusion-related sulfide deposits are the major hosts for Ni and PGE in the world. Meanwhile, this type of deposit hosts significant Cu. The Jinchuan Cu-Ni(PGE) sulfide deposit is the third largest magmatic sulfide deposit in the world, providing an ideal opportunity to better understand magmatic sulfide ore genesis and exploration. Origin and emplacement processes of sulfide-bearing magmas are essential to ore prospecting for magmatic sulfide deposits. Therefore, this project aims to examine the "magmatic conduit system" of the Jinchuan deposit and to explore the possibility to use a three dimensional ore exploration model to guide mineral resource prospecting. Based on detailed field, mineralogical, petrological and geochemical studies, we have several important findings. There is a major breakthrough in the study of the direction of the magma conduit. A model for the origin of the layered intrusions is now well established. The results have general implication for the exploration of not only world class magmatic sulfide deposits but also some hydrothermal deposits, such as skarn-type deposit.

Part C: Research Output

8. Peer-reviewed journal publication(s) arising directly from this research project

(Please attach a copy of each publication and/or the letter of acceptance if not yet submitted in the previous progress report(s). All listed publications must acknowledge RGC's funding support by quoting the specific grant reference.))

The Latest Status of Publications	Author(s)	Title and Journal/	Submitted to	Attached	Acknowled	Accessible

Year of publication	Year of Acceptance *(For paper accepted but not yet published)*	Under Review	Under Preparation *(optional)*	***(bold** the authors belonging to the project teams and denote the corresponding author with an asterisk*)*	Book *(with the volume, pages and other necessary publishing details specified)*	RGC *(indicate the year ending of the relevant progress report)*	to this report *(Yes or No)*	ged the support of this Joint Research Scheme *(Yes or No)*	from the institutional repository *(Yes or No)*
2015	2015			Ping-Ping Liu, Mei-Fu Zhou, Dan-Ping Yan, Guo-Chun Zhao, Shang-Guo Su, Xiao-Lin Wang	The Shangzhuang Fe-Ti oxide-bearing layered mafic intrusion, northeast of Beijing (North China): Implications for the mantle source of the giant Late Mesozoic magmatic event in the North China Craton. Lithos 231, 1–15.	2015	yes	yes	yes
2014	2014			Shang-Guo Su, Zhong-Li Tang, Zhao-Hua Luo, Jin-Fu Deng, Guang-Ying Wu, Mei-Fu Zhou, Chen Song, Qing-Hui Xiao	Magmatic conduit metallogenic system	2014	yes	no	yes

9. Recognized international conference(s) in which paper(s) related to this research project was/were delivered

(Please attach a copy of each delivered paper. All listed papers must acknowledge RGC's funding support by quoting the specific grant reference.)

Month/Year/ Place	Title	Conference Name	Submitted to RGC *(indicate the year ending of the relevant progress report)*	Attached to this report *(Yes or No)*	Acknowledged the support of this Joint Research Scheme *(Yes or No)*	Accessible from the institutional repository *(Yes or No)*

10. Student(s) trained

(Please attach a copy of the title page of the thesis.)

Name	Degree registered for	Date of registration	Date of thesis submission/ graduation
Pingping Liu	PhD	09/2010	10/2014

PengFei Zhang	PhD	11/2013	12/2017

11. Other impact *(e.g. award of patents or prizes, collaboration with other research institutions, technology transfer, etc.)*

This joint project has resulted in close collaboration with the University of Geosciences in Beijing. There are exchanges of scholars including the visits of professors from CUGB to HKU. The PI has also given several seminars at the CUGB. Hopefully this linkage will continue and result in more collaborations in the near future.