

# INTERNATIONAL GEOSCIENCE PROGRAMME (IGCP)

## Annual Report\* of IGCP Project No. 510

\*The information in this report will also be used for publication in 'Geological Correlation' (please feel free to attach any additional information you may consider relevant to the assessment of your project).

IGCP project short title: **A-type Granites and Related Rocks through Time**

Duration: **2005–2009**

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Date of submission of report: 15 December 2005

Signature of project leader:

O. Tapani Rämö

on behalf of Roberto Dall'Agnol, Carol D. Frost, and Laurence J. Robb

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## 1. Website addresses related to the project

### The main website of the project:

Until 31 December 2005: [http://www2.una.edu/physics/IGCP\\_510/IGCP-510.htm](http://www2.una.edu/physics/IGCP_510/IGCP-510.htm)

From 1 January 2006: <http://www.igcp-510.org>

### Personal websites of project leaders:

R. Dall' Agnol: <http://www.abc.org.br/org/aca.asp?codigo=robdal>

C.D. Frost: <http://home.gg.uwyo.edu/Person.aspx?ID=16>

O.T. Rämö: <http://www.helsinki.fi/geology/personnel/tramo.html>

L.J. Robb: <http://www.wits.ac.za/geosciences/egri/staff.htm>

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## 2. Summary of major past achievements of the project

N/A

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## 3. Achievements of the project this year

### 3.1. List of countries involved in the project (\*countries active this year):

The project is truly international in character and has participants from Europe, North America, South America, Africa, Asia, and Australia (in total, from 38 countries):

Argentina\*  
Australia\*  
Austria  
Belgium\*  
Brazil\*  
Cameroon  
Canada\*  
Czech Republic  
Egypt  
Estonia\*  
Finland\*  
France\*  
Germany\*  
India

Ireland\*  
 Italy\*  
 Japan\*  
 Netherlands  
 Norway\*  
 People's Republic of China\*  
 Poland\*  
 Portugal\*  
 Republic of Korea\*  
 Romania\*  
 Russia\*  
 Slovakia\*  
 South Africa\*  
 Spain\*  
 Sweden  
 Switzerland  
 Taiwan  
 Turkey\*  
 Ukraine  
 United Kingdom\*  
 United States of America\*  
 Uruguay  
 Venezuela  
 Yugoslavia

### 3.2. *General scientific achievements (including societal benefits)*

In the first year (and now seven months past the inaugural meeting) of the project, it is premature to comprehensively acknowledge new scientific achievements. In order to pave the way for future scientific breakthroughs in the understanding of the A-type granites, the general goals of the project (see Section 4.1) have been refined in concert with the April 14, 2005 recommendations of the IGCP Scientific Board:

- (1) We have invited Professor Laurence J. Robb (University of Witwatersrand) as a further co-leader of the project. Professor Robb has a strong background and expertise in economic geology.
- (2) Exploration and mining companies (e.g., Companhia Vale do Rio Doce and Mineração Taboca, Brazil) have been approached to promote the project. This will materialize in conjunction with the 2006 annual meeting that will be held in Belém, Brazil with field trips to mineralized A-type granites of Carajás and Pitinga regions (see Section 3.1).
- (3) Scientists from the less developed countries in Asia, China, Russia, Latin America, and Africa have been actively recruited to the project (see section 3.1).
- (4) Young researchers (at the doctoral and post-doctoral level) have already been involved in the project and we will actively recruit further individuals in the future.

Please note also that the outcome of the inaugural meeting of the project (a

special session under the theme *A-type Granites and Related Rocks through Time* in conjunction with the 15<sup>th</sup> V.M. Goldschmidt Conference in May 2005 in Moscow, Idaho – see Section 3.3) will materialize in a comprehensive (~20 original papers) special issue of *Lithos* (Elsevier B.V.) with C.D. Frost, O.T. Rämö, and R. Dall’Agnol as guest editors (see Section 3.6).

### 3.3. List of meetings with approximate attendance and number of countries

In 2005, the project arranged an/or sponsored three international meetings:

(1) May 20-25: As the inaugural meeting of IGCP-510, a special session “*A-type Granites and Related Rocks through Time*” was arranged in conjunction with the 15<sup>th</sup> Annual V.M. Goldschmidt Conference in May 2005 in Moscow, Idaho, USA. The session was convened by C.D. Frost, R. Dall’Agnol, and O.T. Rämö and it was attended by 32 individuals from eleven countries (*Argentina, Brazil, Canada, Finland, Japan, People’s Republic of China, Portugal, Republic of Korea, Russia, United Kingdom, United States*). A total of 22 papers were given on various themes of the project – the abstracts can be found in Podosek (2005) (Section 3.6).

(2) May 26-30: The first IGCP-510 field trip “*Extrusive A-type magmatism of the Yellowstone hot spot track*” was arranged immediately after the Goldschmidt Conference to examine the Neogene to Recent extrusive A-type magmatism of the Snake River Plain - Yellowstone region. Specific themes on the field trip included the 2.0, 1.2, and 0.6 Ma A-type rhyolitic eruptions of the Yellowstone caldera and Recent ferrobasalts that are the extrusive equivalents of the ferrodiorites of AMGC complexes (see Frost et al., 2005 – Section 3.6). The trip was led by Carol Frost, Mike McCurry (Idaho State University), Bob Christiansen (U.S. Geological Survey, Menlo Park), and Keith Putirka (California State University, Fresno), and Mel Kuntz (U.S. Geological Survey, Denver) and it was attended by 27 individuals from nine countries (*Argentina, Australia, Brazil, Finland, France, Japan, People’s Republic of China, Russia, United States*).

(3) September 11-17: IGCP-510 also co-sponsored the Eurogranites 2005 field conference to southern and central Finland (see Rämö et al., 2005 – Section 3.6). The conference brought together 47 individuals from 15 countries (*Belgium, Estonia, Finland, France, Germany, Ireland, Italy, Japan, Norway, Poland, Romania, Slovakia, Spain, United Kingdom, United States*) to examine the origin and significance of Proterozoic and Archean granitoid rocks along a traverse from the southern to east-central Finland. Specific targets included (i) the classic A-type ~1.64 Ga rapakivi granites and related mafic rocks of southeastern Finland; (ii) the orogenic granitoids of the ~1.9 Ga Svecofennian orogen; and (iii) the sanukitoids, TTG suites, and A-type granites of the late Archean Karelian craton.

### 3.4. Educational, training or capacity building activities

In the first three 2005 meetings of the project (technical session and field trip in the northwestern United States, field conference in Finland), doctoral and post-doctoral students from several countries have been actively involved. In the future, we will promote the educational aspect of the project by recruiting

further students especially from the less developed countries.

### 3.5. *Participation of scientists from developing countries*

A substantial fraction of the known (and presumably also the unraveled) occurrences of A-type granites are located in the less developed countries (Africa, Asia, Latin America etc.), and the project will actively recruit new delegates from these regions. For the current IGCP-510 representatives from the developed countries, see Sections 3.1 and 3.3.

### 3.6. *List of most important publications (including maps)\**

#### Peer-reviewed papers:

- 10 R. Minghua, P.A. Omenda, E.Y. Anthony, J.C. White, R. Macdonald, D.K. Bailey (2006) Application of the QUILF thermobarometer to the peralkaline trachytes and pantellerites of the Eburry volcanic complex, East African Rift, Kenya. *Lithos*, in press.
- 8 J.B. Whalen, V.J. McNicoll, C.R. van Staal, C.J. Lissenberg, F.J. Longstaffe, G.A. Jenner, O. van Breemen (2006) Spatial, temporal and geochemical characteristics of Silurian collision-zone magmatism, Newfoundland Appalachians: an example of a rapidly evolving magmatic system related to slab break-off. *Lithos*, in press.
- 7 J.P. Calzia, O.T. Rämö (2005) Middle Miocene rapakivi granites of Death Valley. *Earth-Science Reviews* 73, 221-243.
- 3 L.S. Lauri, O.T. Rämö, H. Huhma, I. Mänttari, J. Räsänen (2006) Petrogenesis of silicic magmatism related to the ~2.44 Ga rifting of Archean crust in Koillismaa, eastern Finland. *Lithos* 86, 137-166.
- 2 D.B. Stoesser, C.D. Frost (2005) Nd, Pb, Sr, and O isotopic characterization of the Saudi Arabian Shield. *Chemical Geology*, in press (available online 15 December 2005).
- 1 B.A. Elliott, W.H. Peck, O.T. Rämö, M. Vaasjoki, M. Nironen (2005) Magmatic zircon oxygen isotopes of 1.88-1.87 Ga orogenic and 1.65-1.54 Ga anorogenic magmatism in Finland. *Mineralogy and Petrology* 85, 223-241.

#### Other publications:

- 9 O.T. Rämö, I. Haapala (2005) Rapakivi granites. *Elsevier Developments in Precambrian Geology* 14, 533-562.
- 6 O.T. Rämö, J. Halla, M. Nironen, L.S. Lauri, M. Kurhila, A. Käpyaho, P. Sorjonen-Ward, O. Äikäs (2005) EUROGRANITES 2005 - Proterozoic and Archean Granites and Related Rocks of the Finnish Precambrian. Eurogranites 2005 Field Conference, September 11-17, 2005. *Publications of the Department of Geology A1*, 130 pp.
- 5 C. Frost, M. McCurry, B. Christiansen, K. Putirka, M. Kuntz (2005) Extrusive

A-type magmatism of the Yellowstone hot spot track, 15th Goldschmidt Conference Field Trip AC-4. *Field Trip Guide, University of Wyoming*, 76 pp. plus an appended map.

- 4 F.A. Podosek (Ed.) (2005) Goldschmidt Conference Abstracts 2005, A-type Granites and Related Rocks. *Geochimica et Cosmochimica Acta* 69 (10S), A79-A89.

\* Numbers above refer to the assigned IGCP-510 publication number. Please note also that the project leaders are currently editing a special issue of *Lithos* (Elsevier B.V.) that is based on presentations given at the inaugural meeting of the project and will comprise the following papers dealing with various aspects of IGCP-510:

1. Introduction to the special issue: **Carol D. Frost, Roberto Dall'Agnol, O. Tapani Ramo**, "IGCP-510: A-type granites and related rocks through time."
2. Review article: **Bernard Bonin**, A-type granites and related rocks: evolution of a concept, problems and prospects.
3. **Eric Christiansen, Ilmari Haapala, and Garret Hart**, Are Cenozoic topaz rhyolites the eruptive equivalents of rapakivi granites?
4. **Cal Barnes, Yuija Li, and Melanie Barnes**, Widespread Grenville-age AMGC-type magmatism in southern Laurentia, Texas and New Mexico.
5. **Ilmari Haapala and Stephen Frindt**, The Cretaceous Gross Spitzkoppe stock in Namibia, a genuine A-type granite related to continental rifting.
6. **Antonina Vernikovskaya, Valery Vernikovskiy, and Michael Wingate**, Neoproterozoic A-type granites of the Yenisey Ridge fold belt, western margin of the Siberian Craton: geochemistry, geochronology and geodynamics.
7. **Janet Hergt and Jon Woodhead**, A-type magmatism in the Western Lachlan Fold Belt? A study of granites and rhyolites from the Grampians region, Western Victoria.
8. **A.M. Larin, E.B. Salnikova, A.B. Kotov, M.K. Sukhanov, V.P. Kovach, S.D. Velikoslavinsky**, Late Archean Kalar igneous complex (Siberian Craton) - the oldest example of the anorthosite-mangerite-charnockite-granite complex.
9. **Daniel Rubiolo**, A-type magmatism in the Central Andes: petrogenesis of Hornillos Laccolith, NW Argentina.
10. **Silvio R.F. Vlach and Guilherme A.R. Gualda**, Allanite and chevkinite in A-type granites and syenites of the Graciosa Province, southern Brazil.
11. **Zhaoli Li, Ruizhong Hu, Jiantang Peng, Yongchun Zheng, Xianwu Bi, Yan Shuang**. The Relationship Between A-type Qitianling granites and the Furong tin ore-formation in Hunan Province, China.
12. **Maria de Lourdes da Silva Rosa, Herbet Conceição, Moacir José Buenano Macambira, Marco Antonio Galarza, Moacyr Moura Marinho, Débora Correia Rios, Basílio Cruz Filho**, Age and genesis of the blue sodalite syenite dimension stone: Neoproterozoic anorogenic magmatism in the South Bahia Alkaline Province of NE Brazil.
13. **Lauro V. S. Nardi, Jorge Plá Cid, Maria de Fátima Bitencourt and Larissa Stabel**, Geochemistry and petrogenesis of post-collisional ultrapotassic syenites and granites from southernmost Brazil: the Piquiri Syenitic Massif.
14. **D.Boztug, Y. Harlavan, And G.B. Arehart**, K-Ar age, whole-rock and stable isotope geochemistry of A-type granitoids in the Divrigi-Sivas region, Turkey.
15. **Chun-Sheng Wei, Yong-Fei Zheng and Zi-Fu Zhao**,  $^{207}\text{Pb}$ - $^{208}\text{Pb}$  decoupling of common lead isotopes of alkali feldspar from a Cretaceous A-type granite in

eastern China with implications for magma dynamics.

16. **Konopelko, D.**, Post-collisional granites of the Kokshaal Range, southern Tien Shan, Kyrgyzstan: age, petrogenesis and regional tectonic implications.
17. **Kumar, K.V., Frost, C.D., Frost, B.R., Chamberlain, K.R.**, The Origin of the Chimakurti-Errakonda-Uppalapadu Plutons, Eastern Ghats Belt, India: An Unusual Association of Tholeiitic, A-type and Potassic Alkaline Magmatism

### 3.7. *Activities involving other IGCP projects or the IUGS*

N/A.

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## 4. **Activities planned**

### 4.1. *General goals*

The general goals of the project focus on correlating the petrology, geochronology, geochemistry, and metallogeny of A-type granites found in various tectonic settings through the geologic time and on a global scale. Specific themes that will be scrutinized include

- (1) age distribution, petrotectonic associations, and genetic models of A-type granites and related rocks;
- (2) their significance in metallogeny;
- (3) their bearing on granite typology and evaluation of hitherto proposed classifications; and
- (4) their overall role in the evolution of the Earth's lithosphere.

Future meetings of the project will target on all of these issues, with special focus on one or two of them at a time, depending on the overall lithologic framework that dominates each convention venue. The project will initiate a global-scale data base of A-type granites that will serve as a comprehensive base in pursuit of the goals of the project.

### 4.2. *Specific meetings and field trips*

The following symposia and field trips are planned and the agenda will be kept open for further timely meetings that might be proposed in the course of the project. Delegates from the less developed countries will be endorsed for all meetings.

#### The year 2006

The **Second Annual Meeting** of IGCP-510 will be held at the Federal University of Pará, Belém, Brazil under the theme "*Magmatism, crustal evolution, and metallogeny of Carajás and adjacent provinces with emphasis on Archean and Paleoproterozoic A-type granites*" on August 7-9, 2006. The meeting will be chaired by R. Dall'Agnol and it will be associated with field trips to the Paleoproterozoic Zr-Nb-Sn-mineralized A-type granite in Pitinga, Amazonas on August 3-5, 2006, and to the Carajas region (reduced and

oxidized Paleoproterozoic A-type granites and the Archean alkaline granites, with granite typology, A-type granite evolution through time, and associated iron, manganese, copper, gold, and nickel mineralization at focus) on August 11-13, 2006.

#### The year 2007

The **Third Annual Meeting** will be arranged in conjunction with the 6th Hutton Symposium on Granites and Related Rocks that will be held in Stellenbosch, South Africa. Regional field trips will run in South Africa, Namibia, and Botswana, featuring, for example, the A-type granites associated with the Paleoproterozoic Bushveld layered mafic intrusion and the Neoproterozoic Gaborone A-type granite-anorthosite complex.

A **Field Conference** will be arranged in the Colorado River extensional corridor–southern Death Valley–northern Mojave Desert region, focusing on the Miocene plutonic and subvolcanic A-type suites of the Basin and Range Province in the southwestern United States. The field conference will be followed by an IGCP-510-oriented thematic session at the Geological Society of America Annual Meeting in Denver in October 2007.

#### The year 2008

The **Fourth Annual Meeting** in Australia/China. Regional field trips in Australia to the Mt. Isa region, South Australia, and Lachlan Fold Belt, and in China to the Beijing region. In 2006, we will be actively recruiting a prominent conference venue for IGCP-510 in Asia or Australia.

A **Field Conference** to Corsica in the Propriano-Bonifatto area. This conference will be chaired by Professor Bernard Bonin (Universite de Paris-Sud) and will cover a varied collage of A-type suites: volcanic calderas, layered mafic chamber and a complete set of felsic rock types ranging from monzonite to syenite to alkali-feldspar granite, with hypersolvus to transsolvus to subsolvus alkali-feldspar mineralogy, and metaluminous to peraluminous or peralkaline compositions.

#### The year 2009

The **Fifth Annual Meeting** in Helsinki, Finland (chaired by O.T. Rämö). Regional field trips to the A-type granite suites in Finland, Russia, and Sweden.

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## 5. Project funding requested

In order to grant the participation of the maximum possible number of delegates from the less developed countries in the 2006 symposium in Brazil, we request for maximum project funding for 2006. This would enhance the contribution to the project from such locations as Asia (central Asia, China), Africa (Cameroon, Ethiopia), and the rest of Latin America that are known to host a great number of vaguely studied A-type complexes.

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## 6. Request for extension, on-extended-term-status, or intention to propose successor project

N/A

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## 7. Financial statement

The IUGS/UNESCO funds allocated to IGCP-510 in 2005 (in total, \$US 5000) were dispatched as follows:

Support in partial reimbursement of expenses incurred upon participating in the inaugural symposium (Moscow, Idaho) and field trip (Yellowstone hot spot track) to the following individuals, \$US 950 for each, in total \$US 4750:

Dr. Durmus Boztug, Geological Engineering Dept., Cumhuriyet University, TURKEY

Dr. Maria L.S. Rosa, Laboratório de Petrologia Aplicada à Pesquisa Mineral, Salvador, BRAZIL

Dr. Daniel Rubiolo, CONICET-SEGEMAR, Buenos Aires, ARGENTINA

Dr. Antonina Vernikovskaya, Russian Academy of Sciences, Siberian Branch, RUSSIA

Dr. ChunSheng Wei, University of Science and Technology of China, Hefei, CHINA

The remainder of the IUGS/UNESCO funds (\$US 250) was used for administrative expenses (postage, telephone).

The project management was also able to raise, largely because of the IGCP status, some monetary support (in total, 2600 €) from the Finnish National IGCP Committee (Academy of Finland) for the expenses of the Eurogranites 2005 field conference.