



International Lithosphere Program

— Task force PROPOSAL for 2015-2020 —

Task Force Name : **Subduction across scales (SAS)**
Task Force No. : #
Task Force Leader(s) : Philippe **Agard** (UPMC, France), Taras **Gerya** (ETH Zürich, Switzerland), Sarah **Penniston-Dorland** (Univ. Maryland, USA), Jafar **Omrani** (Geol. Survey, Iran), Agustin **Cardona Molina** (Univ. Medellin, Colombia).

Keywords : *subduction processes, rheologies and relevant timescales, integrated fluxes of fluids and rocks, exhumed examples of plate interface, numerical modelling across scales*

1. Objectives

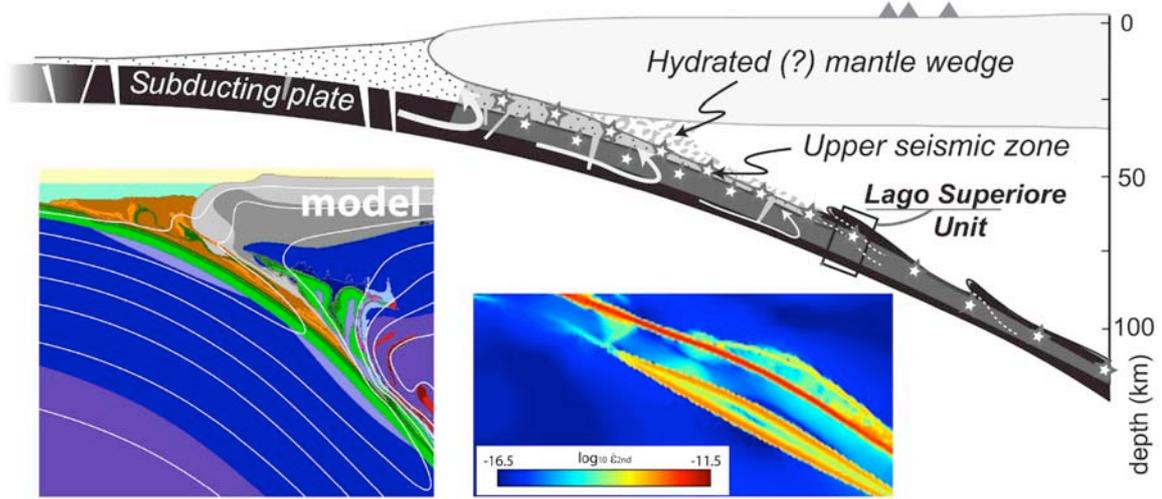
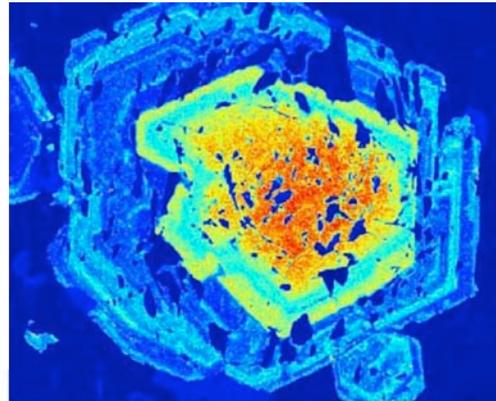
Subduction zones play a fundamental role in our daily life. Half of the world population lives on top or nearby one of them, in coastal areas repeatedly devastated by large earthquakes, tsunamis or volcanic eruptions. Giant earthquakes occurring on subduction zone mega-thrusts (Mw close to 9 or larger) are indeed amongst the deadliest natural hazards. During the last decade, very large earthquakes took many lives (Sumatra, Chile, Japan) and, according to the World Bank, over 200 billion € for the 2011 Japan earthquake.

These dramatic phenomena are fundamentally controlled by the mechanical coupling and global material transfer at and across subduction zone inter-plate boundaries, between the down-going subducting plate and the overriding plate. Stresses and energy release via earthquakes together with fluid-mediated mass transfer are indeed highly focused on the plate interface, where they interact on a wide range of spatial and temporal scales, both at short- (10^{-4} yr) and longer timescales (10^6 yr). **One of the key aspects is therefore to understand the rheology and fluid behavior of the subduction interface at depths of ~10-120 km and relevant space-time scales.**

Understanding the complex interplay of processes acting along subduction zones represents a real challenge for geosciences and requires innovative, high-end, cross-disciplinary scientific and technologic thinking. This scientific effort is mandatory for risk assessment, to enhance the reliability of early-warning systems and help reduce human loss and economic costs. Educational outreach in vulnerable countries is also crucial to explain the seismic, tectonic and tsunamic processes both to politics and populations.

The proposed Task Force "Subduction across scales" builds on past experience from ILP Task Force IX DISC, on the ZIP ITN project (~4 M€; <http://www.zip-itn.eu/>, led by P. Agard, together with T. Gerya) and the EFIRE NSF-PIRE (~5 M\$; led by S. Penniston-Dorland), which was recently recommended for funding (Aug. 2015).

After fostering on promoting cross-disciplinary interactions through the ILP Task Force IX DISC activities, the proposed SAS Task Force intends now to essentially focus on multi-scalar aspects of subduction-zone processes, in both space and time, via scientific interactions at the highest level and across a more diverse, global panel of scientists and expertise.



Courtesy Jonas Ruh

"SAS": focus on multi-scalar aspects of subduction-zone processes, in both space and time!

One of the central objectives is to approach the behaviour of the subduction plate interface through multi-scalar, cross-disciplinary studies (e.g., petrology-geophysics-modelling-rheology-...), with the ambition of:

- improving our resolution and understanding of subduction-zone processes down to a few 100s of meters and 100-1000 years,
- covering the full range of relevant timescales (and understanding their respective influence), from the seismic cycle to exhumation processes, or to the characteristic duration of plate kinematics .

This task force will also be multi-scalar in the sense that, compared to DISC, it will involve scientists beyond Europe and the USA and use natural examples of high potential yet still poorly studied: for exemple the ideal exposures of Iran (see the Workshop organized by DISC in Nov. 2015) or South America (Ecuador, Columbia). The participation in TF SAS of scientists from these countries, namely Jafar Omrani (Geol. Survey of Iran) and Agustin Cardona Molina (Univ. Medellin, Colombia), will ensure real progress in this direction and guarantees the expansion of TF SAS outside Europe. Subduction across scales will also expand further in the USA through the EFIRE-ZIP collaboration.

On a short-term, the "Subduction across scales" Task Force will pay particular attention to:

- **Promoting scientific interactions, particularly to the benefice of young scientists,**
- **Editing a Special volume after the EGU and AGU 2015 sessions: this is an obvious task for getting this done by 2016**
- **Organizing a Summer school, most probably in 2017 (possibly in Paris)**
- **The exchange of scientists, particulary to and from those outside US and Europe.**
- **Establishing a dedicated Website.** This was delayed **for Task Force IX, in part** due to the time lag between setting up the ILP scientific Task Force (IX) and gaining renewed interest in subduction zone processes (thanks to topical sessions at EGU, AGU, GSA,...) and due to the lack of time. This website would now also benefit from the experience gained through the ZIP website, for example.

Future mid-term regional targets and collaborations include:

— **the Far East:** increase the impact in the East (China, Japan, Indonesia, Australia, New Zealand...) and involve into the NSF New Zealand target site. This also includes strengthening the ties recently established with Chinese scientists, who participated to ZIP/ILP 2014 workshop. An international conference on subduction processes should be held within ZIP in Beijing in 2017.

— **South America:** Colombia, Ecuador and Chili. In the latter country, within the frame of ZIP, a major 2-3 weeks event atop the Andean subduction zone is already organized in october 10-17, 2015.

Philippe Agard

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Scientific Expertise:

Geodynamics, metamorphic petrology, tectonics / Subduction zones, Obduction processes, Regional-scale geodynamic reconstructions, Quantitative petrology and rheology

Publications : 61 peer-reviewed publications since 1999
H-index : 25 / **citations :** 2213 (ISI Web of sci.)

* <https://sites.google.com/site/philippeagard/>

Training & Professional experience :

Since october 2011: Member of Institut Universitaire de France
Since 2009 : Professor, UPMC (Univ. Paris 6)
1999-2009 : Maître de conférences (Assistant professor), Univ. Paris 6
2007 : Habilitation à diriger des recherches
1994-1998 : PhD thesis "entitled "Evolution métamorphique et structurale des métapélites océaniques dans l'orogène alpin : l'exemple des Schistes Lustrés (Alpes Cottiennes)"
1996-1997 : Scientific attaché at the french embassy in Hanoi (military service)
1991-1995 : Student of Ecole Normale Supérieure, Paris
Langages : Anglais (fluent), Persian/Italian (spoken), Vietnamese/Spanish/German/Japanese (spoken/forgotten to some extent)

Main administration duties

- PI of the european ITN-Marie Curie ZIP ("Zooming in between plates", 4M€, 2013-2017), of the french ANR Blanche "O:NLAP" (0,4M€; 2011-2014) and of the Int. Lith. Prog. task force "Subduction Channel Processes" (2011-2015)
- Head of Earth Science undergraduate studies at UPMC since 2011
- Coordinator of the "Terre vivante et environnement" Department (1 of the 4 scientific departments at UPMC) since 2012 and Deputy-director of OSU Ecce Terra (1500 p.) since 2011

Five major publications

- Agard P., Monié P., Goffé B. & Jolivet L. "In situ laser probe $40\text{Ar}/39\text{Ar}$ constraints on the exhumation of the Schistes Lustrés unit : geodynamic implications for the evolution of the Western Alps", 2002. *Journal of metamorphic geology*, 20, 599-618.
- Agard P., Omrani J., Jolivet L. & Mouthereau F. Convergence history across Zagros (Iran): constraints from collisional and earlier deformation. *International Journal of Earth Sciences*, 94, 401-419, doi 10.1007/s00531-005-0481-4
- Agard P., Jolivet L., Vrielynck B., Burov E. & Monié P., 2007, Plate acceleration : the obduction trigger? *Earth and Planetary Science Letters*, 258, 428-441.
- Agard P., Yamato P., Jolivet L., Burov E., Exhumation of oceanic blueschists and eclogites in subduction zones: timing and mechanisms, *Earth Science Reviews*, 92, 53-79, doi: 10.1016/j.earscirev.2008.11.002
- Angiboust S., Agard P., Yamato P., Raimbourg H., Huet, B., 2012. Eclogite breccias in a subducted ophiolite: a record of intermediate-depth earthquakes? *Geology*, doi 10.1130/G32925