CRYSTAL2PLATE is an EC FP7-funded Marie Curie Initial Training Network coordinated by **Dr. Andréa Tommasi** from Géosciences Montpellier, Université Montpellier 2, France. It is a coherent training and career development platform for early stage and experienced scientists in Geodynamics, Geochemistry, Petrology, Fluid Mechanics and Seismology. Crystal2Plate brings together 7 European academic institutions: the universities of Montpellier 2 (F), Bristol (UK), Utrecht (NL), and Roma TRE (I), the ETH Zurich (CH), the CNRS (F) and the CISC (E) and 4 associated industrial partners: Rockfield, Oxford Instruments, Schlumberger & Total.

CRYSTAL2PLATE objectives are to provide 10 early-stage researchers, which are all engaged in PhD programs in the partner institutions, and 2 junior post-doctoral fellows an experience-based training through cross-disciplinary research projects that combine case studies in target areas with new developments in seismology, geochemistry, laboratory and numerical modelling of the mantle from the mm to the global scale. These multidisciplinary projects aim to answer a key question in Earth Sciences: **"How does plate tectonics work?"**. A key point in these studies is the investigation of the role of crystal-scale physical and chemical processes on the development of self-consistent plates tectonics in response to mantle convection.

CRYSTAL2PLATE officially started on 1 April, 2009, but already in March 2009, effective web-based presentation of the network and publicity of the training positions were launched. The kick-off meeting was organized in May 2009 in Montpellier (F). By October 2009, a successful international recruitment process resulted in hiring of 9 highly qualified ESRs and 1 ER. The 2 remaining positions were filled in March and September 2010. The gender balance of 58% female is above the target of 50% female researchers. 9 fellows held European nationalities (British, French, German, and Italian), 1 comes from Russia, 1 from Australia and 1 from China. Declarations on the Conformity were submitted to the EC for all 12 appointed fellows, a Consortium Agreement signed, and the 1st prefinancement fully distributed among the partners.

In October 2009, the **1st CRYSTAL2PLATE workshop**, reuniting all network members and 20 external participants, and the 2nd Supervisory Board meeting took place in Montpellier, France. It was followed by a field trip to the Lherz peridotite massif in the Pyrenees.

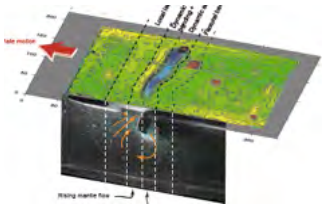
In 2010, 3 short courses (**Processing Seismic data using SAC**, **Textures and Anisotropy**, and **Thermodynamics numerical modelling using PERPLEX**) and a summer school **(Thermal Convection in complex fluids)** were offered. These courses were followed by all CRYSTAL2PLATE fellows and 78 external participants. Assessment by the Supervisory board in Orsay, France in September 2010 showed that all fellows had made satisfactory progress in their research and personal & career training.

The mid-term review meeting took place in Estepona, Spain in January 2011: CRYSTAL2PLATE received an excellent review. It was followed by **2nd CRYSTAL2PLATE workshop**, with discussion sections largely organized by the fellows, and by a field trip to the Ronda peridotite, Spain. Assessment of the fulfilment of the fellows' Personal Career Development plans and satisfaction level in April-May 2011 further evidenced the good functioning of CRYSTAL2PLATE. The 1st Periodic report was filed to the EC in May 2011. Its acceptation prompted a second pre-financing, which was entirely redistributed among the partners.

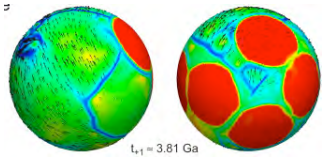
The 3rd annual CRYSTAL2PLATE workshop **"Career Prospectives for Earth Sciences PhDs in Industry and Academia**" was organized in Bristol, UK in January 2012. It offered CRYSTAL2PLATE fellows and 15 external participants a forum for meeting and discussing with representatives of the industrial partners and academic researchers at various stages of their careers.

The 4th annual CRYSTAL2PLATE workshop "**Plate Tectonics on a Convective Mantle: From Crystal-Scale Processes to Global Data and Models**" took place in Fréjus, F in January 2013. It aimed at giving a full picture of the research performed in the frame of the CRYSTAL2PLATE network, offering the opportunity for CRYSTAL2PLATE fellows to confront and discuss their results with leading scientists from institutions external to the network working on similar questions. 26 external early-stage researchers attended this event.

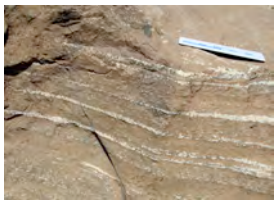
CRYSTAL2PLATE research projects lead to date to 6 PhD degrees and 4 other defences are programmed before Fall 2013. Notable successes obtained by the 10 ESRs and 2ERs include:



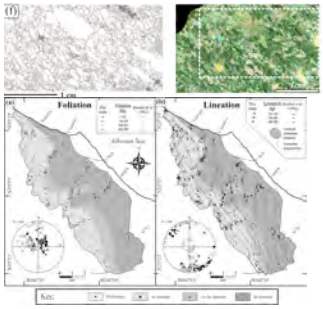
- Follow-up of the evolution of the dynamic topography with time in lithospheric delamination and subduction experiments, allowing discriminating the isostasy, flexure, and dynamic topography contributions.



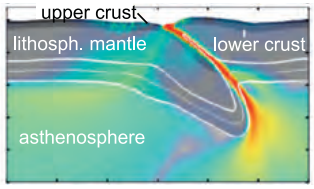
- Implementation of continental plates in a 3D spherical convection code allowing for plate tectonics at yield stresses closer to laboratory-derived values. Successful modelling of supercontinent assembly and dispersion highlights the control of the continents distribution on the mantle potential temperature, surface heat flow, convective wavelength, and on the relation between area and age of oceanic plates.



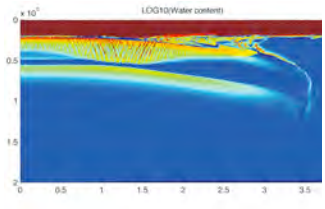
- Microstructural and petrological evidence for strong feedbacks between melts and deformation in the mantle, leading to melt segregation parallel to the shear plane and to a change in olivine deformation processes producing a dispersion of [100] axes in the shear plane. Deformation in presence of melt thus creates distinct seismic and mechanical anisotropies in the upper mantle.



- Petrostructural data in the Beni Bousera peridotite massif highlights the role of transtensional ductile shear zones in thinning the subcontinental mantle lithosphere. It also showed that fast uplift rates and the progressive migration of the deformation towards the hotter (and initially deeper) footwall allow for preservation of steep gradients in deformation conditions and temperature across a continuously evolving shear zone.

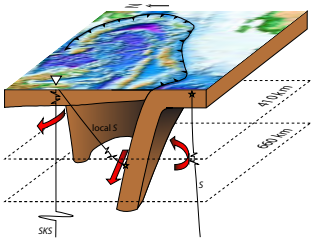


- Parametric study of shear heating-induced and grain-size dependent strain localisation shows that thermal weakening may create localized shear zones that cross-cut the entire lithosphere and evolve into either a subduction or a drip-off instability.

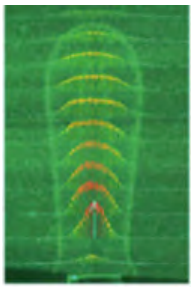


- Implementation of porous flow of fluids in a viscoplastic matrix in the 2D I2VIS numerical code shows that fluid percolation localizes along spontaneously forming faults where high fluid pressure compensates lithostatic pressure, dramatically decreasing friction and leading to subduction initiation. Paradoxical at first, low permeability favors subduction initiation by maintaining high fluid pressure and decreasing friction along active faults.

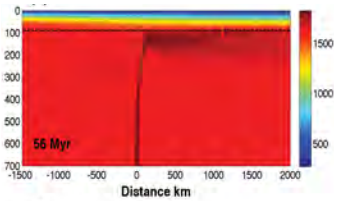
- Combining shear wave splitting on multiple S phases allowed inferring the local mantle flow field and the large-scale deformation of the lithosphere even in complex systems where multiple subduction zones interact, as Indonesia. Direct models of flow and seismic anisotropy in subduction zones show that trench-parallel sub-slab flow is amplified in a double-sided subduction.

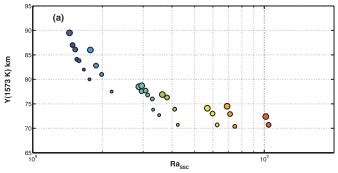


- Development of a new 3D visualization technique for analysing fluid dynamics experiments and full rheological characterisation of a new analog material (Carbopol) that, similarly to rocks, displays a stress- and temperature-dependent rheological behaviour highlights that the shape of the plume head (finger-like) and the strain distribution in both the plume and surrounding media (more localized) in these materials differ strongly from those observed in Newtonian fluids.

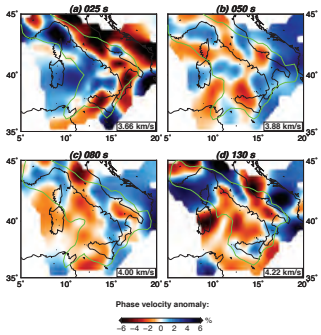


- 2D numerical simulations of the plume– lithosphere interaction beneath moving plates show that small-scale convection (SSC) systematically develops in the plume-fed sublithospheric layer uplifting the 1573K isotherm by up to 30 km. SSC onset time decreases and 1573K isotherm uplift increases with increasing Rayleigh number. For sluggish plumes, SSC onset time decreases with increasing plate velocity. Considering the effect of partial melting on the mantle rheology and buoyancy and on the temperature field results in strongly time-dependent behaviour and, in most cases, lower SSC onset times.

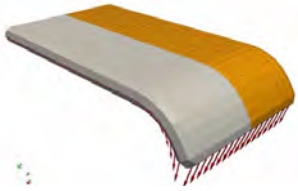




- New isotropic and anisotropic phase velocity maps for the Tyrrhenian sea highlight a pronounced, nearly ring-shaped low velocity anoma-ly surrounding the centre of the Tyrrhenian Sea at ~80 km depth, probably associated with fluids or melts, and marked changes in the orientation of fast Rayleigh wave propagation with depth.



- Development of a 3D boundary-element method (BEM) in combination with an asymptotic theory of thin viscous sheets to study free subduction provided new scaling laws for the instantaneous sinking speed and the lateral deformation of the slab as a function of the `bending length' and of a dimensionless 'stiffness' that quantifies whether subduction is resisted by the viscosity of the sheet or by that of the ambient fluid.



These results have been presented in >45 conferences and gave rise to 38 articles in international peer-reviewed journals, among which 19 articles have been published, 2 are accepted, 4 submitted, and 13 are in final stages of preparation to date.

Publishable Summary – May 2013
For details and regular updates visit our website: http://www.gm.univ-montp2.fr/CRYSTAL2PLATE/home.html
The Crystal2Plate coordination team can be reached at crystal2plate@gm.univ-montp2.fr