

BASIC INFORMATION ON SUB-PROJECT

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| NAME OF PROGRAMME/FUND | Scholarship Fund - Sciex NMS ^{ch} |
| RESEARCH FIELD AND OTHER RESEARCH FIELDS INVOLVED (if applicable) | Earth Sciences |
| TITLE OF THE SUB-PROJECT | Anisotropic Teleseismic TOMographic Code (ATTOC) |
| REGION OF THE CZECH REPUBLIC (according to the location of the home institution) | Prague |
| GRANT AMOUNT SPENT | 31 622,65 CHF |
| INTERMEDIATE BODY | Swissuniversities |
| HOME INSTITUTION | Academy of Sciences of the Czech Republic, Institute of Geophysics |
| HOST INSTITUTION | ETH Zurich Department of Earth Sciences |
| NAME OF THE FELLOW | Helena Munzarová |

ABSTRACT OF THE SUB-PROJECT

Co-operation between the ETH Zurich and the IG Prague dates back to early 1980's and continued in frame of recent large-scale international passive seismological experiments in Europe. Studies of the continental upper mantle include both standard tomography, which images isotropic velocity perturbations in the mantle, and anisotropy studies resulting in modelling structure of the crust and upper mantle, deciphering lithospheric micro-plates, and contributes to understanding European lithosphere dynamics. The fruitful co-operation between the ETH Zurich and IG Prague needs to be delegated on young generation. H. Munzarova, the PhD student of the IG Prague is one of the persons to intensify joint research in the field of seismic anisotropy of the upper mantle. Seismic anisotropy of the Earth upper mantle affects propagation of seismic waves considerably, and usually, it is neglected in isotropic seismic tomography of the upper mantle. Therefore, developing an anisotropic version of a tomographic code is inevitable. In co-operation with Prof. Kissling we will aim at developing a code for simultaneous inversion for both isotropic and anisotropic velocity perturbations. The Anisotropic Teleseismic Tomographic Code (ATTOC) will be an extension of the revisited isotropic tomographic code TELINV, one of the key authors of which is Prof. Kissling and which will be revisited within project RETTOC. The anisotropic code will be tested and applied on data of several passive seismic experiments focused on the structure of the upper mantle beneath Europe, e.g., LAPNET and SVEKALAPKO (northern Europe) and RETREAT (Northern Apennines, Italy) or BOHEMA (central Europe), co-organized by the IG in a broad international co-operation. The anisotropic code will be prepared for its application within the prepared international AlpArray project (lead by ETH Zurich and ISTerre Grenoble) focused on structure and development of the Alps and interactions of European lithosphere with plates colliding from the south.

MAIN RESULTS

This Sciex Fellowship (ATTOC) aimed at modification of standard isotropic tomographic code called TELINV in such a way that it considers anisotropic, i.e., more realistic propagation of seismic waves through the Earth upper mantle.

The main improvements of the isotropic TELINV code, performed during the ATTOC Sciex Fellowship, were

- new definition of a bottom of the model volume;
- calculation and output of parameters estimating resolution of the model after each iteration;
- modification of data weighting and also modification of several output formats;
- comments accompanying the code were completed as well;
- making the package containing the TELINV 2012 isotropic teleseismic tomographic code public available at <http://www.ig.cas.cz/en/research-teaching/software-download/>.

For anisotropic modifications of the isotropic TELINV 2012 code we

- derived equations describing velocity of propagation of P waves in weakly anisotropic media with hexagonal symmetry axes with the use of perturbation theory (Backus, 1965);
- established a linear relation between P-wave travel-time residuals (our data) and perturbations of anisotropic parameters (searched unknowns) related to a reference model;
- wrote a forward mode of the anisotropic code;
- performed several synthetic tests.

Before programming itself, all the individual steps of anisotropic modification were described in detail and discussed by the Fellow and both Mentors during the Home Mentor's visit at ETH Zürich. The forward mode of the program, which calculates travel times of individual waves propagating through anisotropic volume to stations, has been already accomplished and tested. Newly, calculation of ray density tensor, a tool to characterize 3D coverage of a volume by rays, has been incorporated into the code. The next step is creation of the inversion mode, during which the unknown model parameters are determined.

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| DATE OF REALISATION OF THE FELLOWSHIP | 18.3.2013 - 17.9.2013 |
| MORE INFORMATION ON THE PROGRAMME | www.sciex.ch |