

## Letter of evaluation of Nicola Tosi's Ph.D. study

I have known Nicola Tosi since 2003, when he was first accepted as a Ph.D. student at the GeoForschungsZentrum in Potsdam. The original subject of his Ph.D. study was devoted to dealing with thermal convection in the Earth's mantle, with an emphasis on relating spatio-temporal changes in the gravity field induced by mantle flow to observations from the CHAMP, and later the GRACE, space gravity missions. At that time it was already known that the effect of mantle flow on temporal changes in the Earth's gravity field is rather small, in fact below the errors of the CHAMP and GRACE gravity field models. That is why I proposed to change the focus of his research to concentrate on modelling the portion of the present-day, long-wavelength geoid induced by mantle flow. At this point I was asked to supervise Nicola's work. Since much had been done in this field, with many important results published in the geophysical literature, Nicola's work focused on two main issues.

First, the present-day mantle flow was modelled while incorporating a laterally varying viscosity with the aim of showing the influence of lateral viscosity variations on the geoid and other surface observables. Nicola solved this problem by first dealing with mantle flow within a 1-D viscosity distribution, developing the required matrix propagator technique by himself. In the next step, he applied the weak formulation of the boundary-value problems for partial differential equations on the Stokes problem for mantle flow. Based on this theory, he developed a numerical technique incorporating the so-called spectral-finite element method for computing mantle flow with 2-D and 3-D viscosity distributions. There were some problems dealing with how to compute the solution for the spherical harmonics of degree  $n=1$ . That is why he developed semi-analytical test examples based on the eccentricity-nested sphere configuration. This helped him to sort out the problems with the degree-one terms, as well as allowing him to compute the pressure term for the mantle-flow modelling. As a final step, he created the numerical code to compute mantle flow with a fully 3-D viscosity distribution. However, it turned out that the computational demands of this code are too great for the capacity of present-day PC computers.

The second task of Nicola's work was to compute non-hydrostatic pre-stresses induced by mantle flow and to use them as the initial non-hydrostatic pre-stressed field for the modelling of postglacial rebound. Nicola was able to generate the non-hydrostatic pre-stresses induced by mantle flow, but employing this field in the differential equations for postglacial rebound remains a topic for the future.

Nicola enjoys working with theory, both the fundamental "pencil" work, as well as the programming aspects. I admire his writing style for its clear, systematic form. Nicola can work independently, but as with any scientist, he needs to discuss his ideas and results from time to time. In these discussions, he can express his views in a clear way. He has no problem in communicating with people, not only on scientific issues but also on other general topics. Judging from his conference and seminar presentations, Nicola can present and explain scientific topics in a clear and interesting manner.

In summary, Nicola is an excellent scientist with broad and versatile interests. He has demonstrated his flexibility in scientific research several times. I am convinced that he would be able to quickly orient himself and start working on any new scientific problem if necessary.

January 30, 2008

