

A Proposal for Reviving the Mantle Dynamics Workshop

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Abstract. Mantle dynamics community had its last Los Alamos mantle convection workshop in 1997. In this proposal, I propose to revive the mantle dynamics workshop with the newly established CIG as a sponsor. I present the reasons for reviving the workshop and suggest possible format and agenda for the workshop.

Reasons for reviving the workshop. Since the last mantle convection workshop seven years ago, we have seen significant progress in the studies of mantle dynamics both in terms of its science and computational technologies. We have also seen that Earth Sciences become more interdisciplinary with mantle dynamics that is increasingly integrated into the studies of seismology, geochemistry, and mineral physics. Although we geodynamicists interact in various conferences (mostly interdisciplinary conferences), it is also necessary for us to have a more specialized forum or workshop where we can have in-depth discussions on science and techniques that we use. Here I present reasons in detail for such a workshop.

1) *Defining our field and community in the interdisciplinary era.* The increasingly more interdisciplinary approach in Earth Sciences presents both opportunities and challenges to geodynamics. With the interdisciplinary approach, geodynamic modeling is an essential tool that is needed to synthesize various observations and to eventually answer important scientific questions. Such a process helps define new geodynamic problems and promote our field of studies. For example, in the more recent renewed effort among seismologists, geochemists, and geodynamicists in resolving the compositional structure of the mantle and style of mantle convection (layered vs whole mantle), geodynamic modeling has proven to be essential in formulating questions and answering them. However, along with these new opportunities are also new challenges including how we geodynamicists best communicate vigorously with each other about our ideas on geodynamics. Take the thermochemical convection as an example, questions such as how we best understand the physics of thermochemical convection or how we most effectively simulate thermochemical convection arise naturally. Unfortunately, this type of questions cannot be easily discussed in interdisciplinary conferences where the majority of the audience may not care about the questions or may not have adequate background in geodynamics to have fruitful discussions. It is clear that a mantle convection workshop is a more appropriate place to discuss in a vigorous way about these important questions.

In addition, such a workshop should help define our field and community and promote collaboration and exchange of ideas among our colleagues. The workshop will also provide rich soil to nurture our students and post-docs.

2) *Keeping up with the rapidly evolved computational technology.* In the last decade, we have seen rapid improvement in computational technologies in both hardware and software. In the middle of 1990's, parallel computing was only available to a very limited number of geodynamicists who had access to highly specialized high-performance parallel computers at supercomputer centers, and 3D modeling was rare with a rather poor numerical resolution. But in the last several years the Beowulf clusters have really democratized the high-performance parallel computing, and now almost every group can afford parallel computing at a reasonable scale that enables meaningful 3D simulations of mantle dynamics. Parallel computing software for modeling mantle dynamics also becomes more robust and efficient and is available through internet. For example, a suite of CitCom codes (CitcomS and CitcomT) with detailed documentations can be downloaded as a result of the recent effort from the Caltech's Geoframework Project.

However, to make the best use of these resources is not a trivial task. A geodynamics workshop with an aim at introducing these tools to the community is beneficial to our community and our science. In addition, with the collective strength of our community, this workshop will also provide us with opportunities to discuss how we can further improve our modeling technologies and capability for the future. In my view, we certainly still have a long way to go before having a "perfect" tool for modeling mantle dynamics.

The recent establishment of the CIG, of course, provides a best opportunity to have such a workshop, as this type of the workshop was also envisioned in the original plans for CIG.

Plans (really rough) for geodynamics workshop. The workshop may be held in early summer every two years with the first one that may take place in 2005 before or after the Gordon conference. The duration of the workshop may be one week. I anticipate up to 30 participants including students, post-docs and senior researchers. The workshop may have the following broadly defined objectives: 1) Discussions of current research topics in geodynamics, 2) Demonstrations and discussions of new modeling and visualization techniques, 3) Defining standard benchmark problems for mantle convection, 4) Discussions of future directions of our sciences and modeling technologies.

The CIG in Pasadena is an ideal location for the workshop, because of its expertise in modeling software and of hardware setup. To have a successful workshop, it is important to provide participants access to some Beowulf clusters to test and be familiarized with new modeling and visualization tools. Hopefully, the CIG will have some clusters of moderate size with reasonable technique support that is ready for the workshop. Other locations with good internet access are also possible for future workshops. I realize that there may be some potential conflicts with the European mantle dynamics workshops that take place every two years with next one also in 2005 (I am not 100% certain). However, it is my impression that not many US geodynamicists go to the European workshops. It is possible that in future these two workshops may be combined and alternate between the US and Europe.

While participants will surely have a lot of new ideas to contribute regarding to the first two objectives of the workshop, we should also put some thinking into the last two objectives: benchmarks and future modeling technologies. Benchmarks are no doubt important. We should define a set of standard benchmark problems for mantle convection in different geometries (Cartesian and spherical). These benchmark problems will be used to test any new numerical methods that may be developed in the future. They can also be used for users to test some existing codes. Mark Richards, Peter Bunge, and myself have been discussing these benchmark problems for spherical mantle convection for sometime already. Hopefully we will be able to share our ideas on these benchmark problems with everyone during the workshop. To facilitate these benchmark efforts, it is desired to have a benchmark website under the CIG main website. This benchmark website should contain the definitions of benchmark problems and various solutions from different codes. The website should also have the functionality for users to submit and post their own benchmark results.

To have more productive discussions on the future directions of modeling technologies, we may need to invite a few computational scientists (or perhaps CIG will have in-house experts by then) to the workshop to share their ideas.

To summarize, for the workshop to succeed, we may need the following items from the CIG: 1) some PC clusters with reasonable technical and administrative support, 2) expertise in new computational methods and trends, and 3) a well-designed benchmark website.