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Boris Kaus receives 2012 Paul Niggli Medal

The Paul Niggli Medal is Switzerland's most prestigious award for young earth scientist who made outstanding contributions in the research fields of mineralogy, geochemistry, petrology, resource geology or solid-earth geophysics. The Paul Niggli Medal honours and supports young ambassadors of Swiss geoscience, who are either Swiss citizens or have obtained at least two of their academic degrees in the Swiss university system (BSc or MSc and usually their PhD)

The Council of the Paul Niggli Foundation has decided in their session of 24 October 2012 to award the Paul Niggli Medal to Boris Kaus. The 2012 medal is awarded in recognition of Boris Kaus' outstanding research in linking geodynamics, structural geology, magmatic petrology and Earth surface processes by quantitative numerical modelling.

Christoph A. Heinrich for the Board of the Paul Niggli Foundation

Citation

After his birth in Heerlen and basic schooling in Gulpen, The Netherlands, Boris obtained his Vordiplom (BSc) in geology at Aachen University, Germany and his Diplom (MSc) at the ETH Zürich. There, he recognized his strong passion for numerical geodynamic modelling and wrote his first scientific paper about forward and reverse modelling of the three-dimensional Rayleigh–Taylor instability. He continued his Swiss academic education by conducting a PhD project in the field of analytical and numerical modelling of geodynamic processes at ETH Zürich, which resulted in several influential peer-reviewed papers and an excellent PhD thesis "Modelling approaches to geodynamic processes" for which he received the ETH Silver Medal for outstanding doctoral theses in June 2005. Boris then changed continent and went for a postdoc at the University of Southern California in Los Angeles, but since his heart remained with Switzerland he returned to ETH Zürich in 2007 as an Oberassistent, then Assistant Professor of Computational Geodynamics and he won the prestigious European Research Council Starting Grant in 2010. Shortly after, Boris accepted a Full Professorship at the Johannes Gutenberg University in Mainz, Germany, where he started in 2011.

Boris Kaus' scientific interests are very broad and aimed at understanding coupled geodynamical, tectonic and petrological processes on a wide range of scales, from magmatic crystal mushes to the lithosphere and mantle. In particular, he worked on the formation of lithospheric shear zones and explained the thermo-mechanical conditions under which they form and evolve, with specific geological applications. For his influential papers on lithospheric and crustal deformation he received the Arne Richter Award for Outstanding Young Scientists from the European Geosciences Union.

His novel investigations with his PhD students on shear localization phenomena in the crust and lithosphere have clarified the physical controls and feedbacks during both crustal- and lithospheric-scale faulting. What is impressive about Boris Kaus' scientific approach is the thorough and systematic nature of his studies, and the way he combines state of the art numerical simulation using complex visco-elasto-plastic rheologies with simplified mathematical

analyses, in order to understand why and how things happen in nature.

We congratulate Boris for being a world leading young geodynamicist who attacks first order problems and gives us fundamental insights. On 18 November, 2012, Boris' award was announced during the 10th Swiss Geoscience Meeting in Bern—while he was engaged in geological field work in Argentina—but the celebration followed a year later in Lausanne. We wish you continuing joy and success, Boris, in your life and your future research!

Taras Gerya and Paul Tackley (ETH Zürich)

Response

I am extremely honoured to receive the 2012 Paul Niggli Medal, even more being the first geophysicists and the first non-Swiss awardee.

My interest in geosciences started probably around the age of 10 when I started collecting minerals during one of our summer holidays in Switzerland where my grandfather and two uncles lived. It was thus no more than logical to study geology a few years later at Aachen University because of its reputation for field geology. Yet, pretty early on I realized that pure field geology was not my thing as it was too descriptive and required good drawing skills, which I certainly do not have. Structural geology was the most quantitative part of my geology education at that time and the energy of Janos Urai, who was a new professor in Aachen, certainly helped nurture this. During one of my summer visits to Switzerland, I went to the ETH to see if it would be possible to study there for some time. During that visit, I crossed Neil Mancktelow in the hallway who, with his usual enthusiasm, immediately encouraged me to do an exchange semester at the ETH.

So said, so done, and a bit later I started in Zurich, initially for a year. It was there that I first got in touch with numerical modelling through the classes of Yuri Podladchikov. His enormous enthusiasm and insistence that modelling is easy got me completely hooked on the subject. At the end of the semester, which I essentially fully devoted to this topic, he asked whether I was interested in doing a small research project. The project to write a 3D code to model density-driven instabilities turned out to take a bit longer than the 3 weeks he initially estimated. Yet, it definitely started my scientific career and by the end of my exchange year I had presented the first results (obtained the night before) at my first scientific meeting. After that, I switched to ETH to finish my Diploma there, which took a few more years. Doing a PhD was a logical next step interrupted by a memorable few months in Minneapolis visiting Dave Yuen. During my ETH time, I had the luck to be surrounded with people that were all working on modelling, in particular Dani Schmid and Stefan Schmalholz but also Neil Mancktelow, Jamie Connolly and Guy Simpson. I believe that having a critical mass of researchers working on a similar subject is crucial not only as a constant motivation, but also as a big time-saver in finding bugs in the codes. Yuri's famous Friday-seminars were an immense source of inspiration for us all.

At the same time, it helped being in the group of Jean-Pierre Burg who, as a field geologist and tectonicist, was never shy to point out how nature looks different from our models. Yuri left to Norway after my first PhD year. This made me independent; and it taught me what it takes to convince him over the phone about scientific results. This remains a useful skill. Taras Gerya took over shortly afterwards and has been a great colleague from the first day. We had daily and quite vigorous coffee-table discussions. He later mentioned that it became very quiet after I left.

For my postdoc I switched gears and moved to southern California, which was a fantastic environment, but quite different from Switzerland. I had a great time there with Thorsten Becker and was lucky to be involved in teaching and student supervision as well. Yet, once the opportunity arose to move back to Zurich, I did not have to think twice. In the meantime, ETH had established a new professorship devoted to geodynamic modelling, headed by Paul Tackley, and Taras Gerya became part of this group. I guess it is fair to say that this was the largest group worldwide devoted to computational geosciences with about 25 persons, and I was very lucky to be part of the team. In addition, we had a large number of excellent PhD students, postdocs and colleagues who were eager to collaborate. Computer models are only useful if they help to solve geoscientific questions, and it is thus crucial for geodynamicists to work together with other geoscientists in an interdisciplinary manner. Yet, in order to make progress, we also need to work on the computational tools themselves. Here, I feel that quite a bit of progress has been made over the last decade or so, partly driven by the Zurich group, which demonstrated that working on these aspects are not 'technical details' but a legitimate scientific discipline in itself.

I really enjoyed my time in Zurich, but since there was no chance to obtain a permanent position, I moved with part of my group to Mainz once the opportunity arose. Also here, young generations of students seem quite keen to learn more about this exciting research field, so the future looks bright!

Looking back, I believe I have been strongly influenced by Yuri Podladchikov's philosophy, maybe not so much in my actual research topics but more by his general approach to science. A crucial aspect of Yuri's philosophy is that

every modeller should write his/her own code, which was opposite to the common thinking of many in the community at the time. In addition, he showed that it is actually not that difficult to learn how to do this, even with a geology background. And after having taught modelling classes now for quite a few years, I strongly agree with this; mathematicians are not necessarily better at this than geologists. The mistakes they make are typically different but it is motivation and will that matters at the end. Another part of Yuri's philosophy is to not use models to simply draw pretty pictures, but rather as experiments to better understand the underlying physics. Computer models of geological processes tend to have a large number of input parameters, such that understanding what goes on in those models becomes an extremely complicated task. At the same time, you might miss some of the key physics if you use too simplistic models (as Taras Gerya often pointed out). Yuri was maybe one of the first persons to show how a combination of non-dimensionalisation, systematic numerical simulations and the use of analytical solutions and scaling analysis can give incredible insights in the physics of even very complex appearing problems. Armed with this physical insight it becomes possible to predict the outcome of a computer simulation before you do the actual simulation. Whereas we obviously cannot repeat what happened in nature, we can simulate millions of years in a matter of days on a computer. By comparing such models with natural data and by understanding why and for which parameter ranges the models fit reality (and when not!), we can learn a great deal about the Earth as well. Given the numerous unsolved problems, we have a great future ahead!

I thank Taras, Paul but also Evgenii Burov for having proposed me for the Paul Niggli award. I will try to live up to the expectations and keep educating the next generation geoscientist in an interdisciplinary and processes-oriented thinking. Finally, I would be nowhere without the love and strong support of my family. This medal is for them!

Boris Kaus (Johannes Gutenberg University, Mainz)