

2023_30_ESE_Goes: Mapping thermal and compositional structure of cratons

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Background:

Cratons are the ancient cores of Earth's continents that, unlike oceanic plates, have survived billions of years of geologic history. They represent the first step in continental growth, where the subaerial emergence of continents forever changed the climate and conditions for life and made Earth unique in the solar system. The thick strong roots of cratons can sequester chemical elements from Earth's internal recycling, including volatiles, like water and CO₂, that make our planet habitable. Volatiles percolating through the deep cold roots of cratons precipitate diamonds and concentrate metals key for low-carbon technologies in and along craton edges. The formation of cratons and longevity of their roots remains enigmatic.

Rationale:

Recent studies of seismic surface waves by our group reveal that craton keels contain volatile-bearing minerals over much larger scales than thus far understood and in sufficient quantities to alter craton density and strength. Our studies of some of the cratonic cores of North and South America also find significant variability in root structure that likely reflect changes in plate tectonic styles through Earth history and a role of mantle upwellings in modifying craton roots. This information contained in the geophysical structure of mantle roots is only just starting to be analysed and provides an important complement to existing geological and petrological data that could help to unravel mechanisms for craton evolution and longevity.

This project:

This PhD project would involve a comparative study of different cratons in North America, South America, Africa and Australia. For each of the study regions, Monte Carlo inversions would be set up to jointly analyse seismic and density-sensitive data for plausible thermal and compositional structures. This work will answer questions on mechanisms of craton formation and whether all cratons were formed in the same way, and on how craton roots get modified through their history and potentially destroyed, as well as how these processes affect the distribution of volatiles and associated mineralisation.

Our team

The supervisors of the project will be Saskia Goes and Ian Bastow. The student would join a group of about 5 academic staff, about 9 PhD students and 3 postdoctoral researchers that actively work on shallow and deep geophysical imaging, surface processes and plate dynamics.

Student Profile:

We are seeking a highly motivated individual with a background in geophysics, physics, or geology with a strong quantitative foundation. The successful candidate will be able to work independently and have a keen interest to do interdisciplinary work on the dynamics of the deep Earth. For more information on this project please contact Saskia Goes (s.goes@imperial.ac.uk) or Ian Bastow (i.bastow@imperial.ac.uk).

For more information on how to apply to us please visit: <https://www.imperial.ac.uk/grantham/education>