DEPARTMENT OF EARTH SCIENCES
Indian Institute of Technology Kanpur

DEPARTMENT LECTURE SERIES

Insights into Archaean Geology

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Prof. Chris Hawkesworth is an Emeritus Professor at the Universities of Bristol and St Andrews and an Honorary Fellow of St Edmund Hall, University of Oxford. He previously served as Deputy Principal, Vice-Principal for Research, and Wardlaw Professor of Earth Sciences at St Andrews. He graduated from Trinity College Dublin and earned his DPhil from Oxford under Ron Oxburgh.

He is a Fellow of the Royal Society and the Royal Society of Edinburgh, and an Honorary Member of the Royal Irish Academy. His major honours include the Wollaston Medal, Walter H. Bucher Medal, and Victor Moritz Goldschmidt Award.

His research applies isotope geochemistry and trace-element analysis to understand magma generation, continental crust formation and evolution, mineral deposits, and environmental change, with particular emphasis on determining the rates of geological processes.

Archaean geology is different from that in younger terrains. Banded Fe formations and a lack of carbonate reflect the low oxygen environments, and the bimodal granite-greenstone associations arguably reflect distinctive tectonic settings. The discussion about how plate tectonics can be recognised from the geological record is in part about scale, and how the results of different case studies are put in a wider global context. Approaches rely on global data sets (e.g., zircons), in the hope that they are representative, and on analyses of samples from well mixed reservoirs, such as the upper mantle and Sr in sea water. An alternative approach is to consider the consequences of plate tectonics being active, such as changes in the rates of crustal growth.

Subduction and non-subduction magmatic rocks are recognised from 3.8-2.7 Ga, and encouragingly there appear to be links between geochemistry and tectonic style, in that rocks with non-subduction features tend to be associated with dome and basin architecture. Archaean terranes evolve from dome and basin to more linear belts reflecting lateral compression with time, and granulite facies metamorphism provides evidence for crustal thickening by the late Archaean. The development of dyke swarms and large sedimentary basins mark the cooling and increasing rigidity of continental crust, and models will be discussed for the development of dyke swarms. Major and trace element models for the generation of Archaean TTG from Northern Finland yield contrasting results. Moreover, if TTG were generated from sources similar to the associated mafic rocks, it remains unclear how readily bimodal magmatism may be generated by subduction-related processes.

Heat flow evidence suggests Archaean crust was more mafic than the present-day bulk crust, and juvenile continental crust changed from mafic to more intermediate compositions at ca. 3 Ga. A number of crustal evolution models have 50-70 % of the present volume of crust by 3 Ga, requiring a reduction in the rate of crustal growth at that time. This is attributed to an increase in the rates at which differentiated continental crust was destroyed, and that coupled with other changes at the end of the Archaean are taken to reflect the onset of plate tectonics as the dominant global regime.

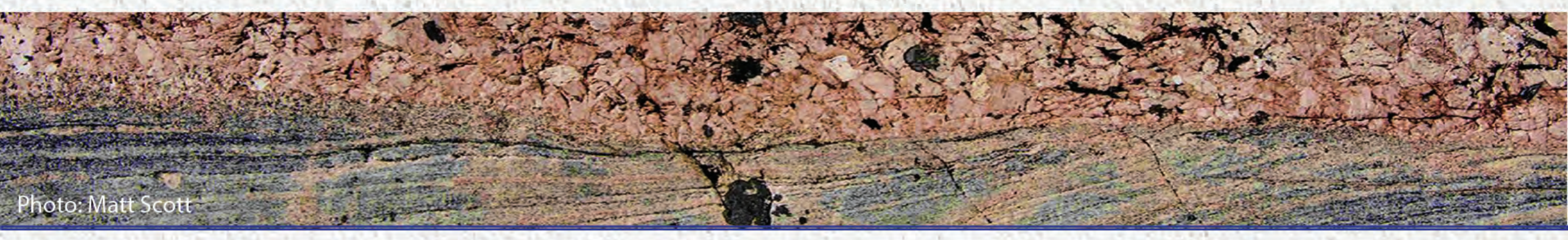


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