

## Teaching the Mantle Plumes Debate

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There is an ongoing debate regarding whether or not mantle plumes exist. This debate has highlighted a number of issues regarding how Earth science is currently practised, and how this feeds into approaches toward teaching students. The plume model is an hypothesis, not a proven fact. And yet many researchers assume a priori that plumes exist. This assumption feeds into teaching. That the plume model is unproven, and that many practising researchers are skeptical, may be at best only mentioned in passing to students, with most teachers assuming that plumes are proven to exist. There is typically little emphasis, in particular in undergraduate teaching, that the origin of melting anomalies is currently uncertain and that scientists do not know all the answers. Little encouragement is given to students to become involved in the debate and to consider the pros and cons for themselves. Typically teachers take the approach that “an answer” (or even “the answer”) must be taught to students. Such a pedagogic approach misses an excellent opportunity to allow students to participate in an important ongoing debate in Earth sciences. It also misses the opportunity to illustrate to students several critical aspects regarding correct application of the scientific method. The scientific method involves attempting to disprove hypotheses, not to prove them. A priori assumptions should be kept uppermost in mind and reconsidered at all stages. Multiple working hypotheses should be entertained. The predictions of a hypothesis should be tested, and unpredicted observations taken as weakening the original hypothesis. Hypotheses should not be endlessly adapted to fit unexpected observations. The difficulty with pedagogic treatment of the mantle plumes debate highlights a general uncertainty about how to teach issues in Earth science that are not yet resolved with certainty. It also represents a missed opportunity to let students experience how scientific theories evolve, warts and all. Working with students to enable them to participate in the evolution of the subject and to share in the excitement of major developments is surely the best way to attract them to science.