Course-embedded projects in undergraduate geoscience education: Research experience, communication skills and programmatic assessment

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Incorporation of research projects in geoscience major's courses have a number of benefits that go beyond determination of individual student grades. It introduces students into the culture of research, generally for the first time. It is also a practical mechanism to educate geoscience students on various aspects of best practices in oral and written communications in the sciences. Finally, it can serve as an effective, relatively noninvasive, means of assessing undergraduate-degree program learning outcomes. In the junior-level Igneous and Metamorphic Petrology course at Louisiana State University (LSU), the assignment called the 'Pet-Rock Project' is the course-embedded research project that permits the attainment of these learning and programmatic goals.

The Pet Rock Project is a semester-long project in which each student is assigned a sample and then follows most of the steps a petrologist would take to analyze and interpret a rock from a known area (Beartooth Mountains, Montana and Wyoming, USA). After preliminary input from the instructor, each student presents revised results of this study in a written form comparable to a professional petrology journal and in an oral form comparable to that given at a professional geology meeting. The Pet Rock Project has been a successful vehicle to provide all undergraduate geology students with a controlled research experience and with an opportunity to instruct students on effective methods of oral and written communication. Rubrics developed for assessment of individual students on this project have been repurposed to examine the level of attainment of the communication learning outcome associated with the BS degree program at LSU.

In 2009 the Pet Rock oral and written communications assignments became the designated means to assess the communication learning outcome for the BS degree in Geology i. e. '*Students will develop the ability to effectively communicate geologic concepts and material in written and oral formats*'. This is appropriate because this course is required of all Geology majors, generally capturing the students within a year of graduation.

Carbonate U-series dating using quadrupole-ICPMS

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The isotopic abundances of uranium and thorium have been widely used to explore physical and chemical processes in several fields of the Earth sciences since they allow to obtain highly precise dates. Nowadays, it involves the measurement of ^{230}Th and ^{234}U by isotope dilution TIMS or MC-ICPMS. Here we explore the possibility of carrying out U-Th dating using inductively coupled plasma-quadrupole mass spectrometry (ICP-QMS) with an APEX-Q introduction system, using a low-purity ^{233}U and ^{229}Th spikes. The methodology routinely yields precisions of ~ 3 ‰ and ~1% for ^{234}U/^{238}U and ^{230}Th/^{238}U, respectively, in samples with 500 ng of uranium. This level of precision was attained by carefully measuring baseline conditions, background, and a detalied calibration of the detector, including high-voltage, discriminator, and pulse couting-analogue calibration. The utility of our analytical technique is illustrated with the dating of two stalagmites that have been previously dated by MC-ICP-MS. The results show that the isotopic compositions measured by our methodology are consistent with those obtained by MC-ICP-MS.