

## What do students learn about stratigraphy?

Sebastian Willman<sup>a</sup>, Abigail K. Barker<sup>a</sup>, Rie H. Malm<sup>b</sup> and Mattias Arrhenius<sup>c</sup>

<sup>a</sup>Department of Earth Sciences, Uppsala university, Uppsala, Sweden, [Sebastian.Willman@geo.uu.se](mailto:Sebastian.Willman@geo.uu.se); [Abigail.Barker@geo.uu.se](mailto:Abigail.Barker@geo.uu.se) <sup>b</sup>Department of Science Education, University of Copenhagen, Copenhagen, Denmark, [Rie.Malm@ind.ku.dk](mailto:Rie.Malm@ind.ku.dk) <sup>c</sup>Department of Education, Uppsala university, Uppsala, Sweden, [Mattias.Arrhenius@edu.uu.se](mailto:Mattias.Arrhenius@edu.uu.se).

Stratigraphy is a fundamental concept in Earth Sciences and presents a variety of challenges to the learner. Stratigraphy encompasses layers of rock that vary spatially and temporally. Our aim was to investigate what students learn and understand about stratigraphy. We studied students learning before and after a one day field excursion in an introductory course in Earth Science at Uppsala University in the autumn 2020. The students were in the first year of their BSc and had just entered university with a school science background, there were 23 students enrolled in the course. We gave them a questionnaire to fill out before they went on the field excursion and a second one for after the excursion, to examine the influence of the fieldwork. We used content analysis to inductively identify critical factors in the responses of both before and after questionnaires. Resource graphs are used to analyse the responses from individuals both before and after fieldwork and look for connections between ideas. Content analysis revealed ten themes within the answers, the content provides a wide range of conceptual understanding from very basic to well developed. There were very few alternative conceptions found within the responses. Resource graphs show a wide range of patterns from a few connected ideas to highly complex interconnected patterns between themes. We found three levels of complexity within the responses. Students who showed little insight, have simple resource graphs with a few connected ideas, they notice minerals, fossils, lithology and layering. They consider the rock record as an archive of time very generally. Moderate insight considers stratigraphy to show order of events, time and depositional environments. Good insight is associated with resources graphs that are complex and feature time, depositional environment and spatial scale. These students make connections between fossils and depositional environment, as well as demonstrating conceptual understanding of sedimentation rate and climate. The analysis thereby show a diversity in the complexity of students conceptual understanding and provide us with insights into the challenges of teaching and learning stratigraphy.