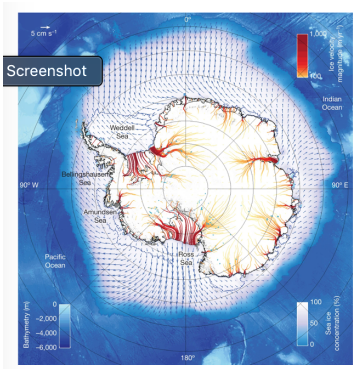
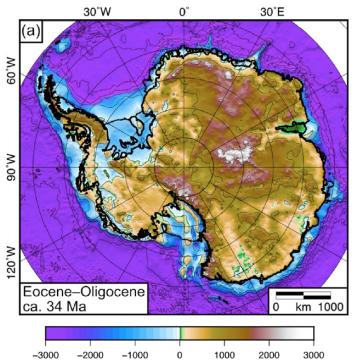
GY400 West Antarctic Ice Sheet history and dynamics

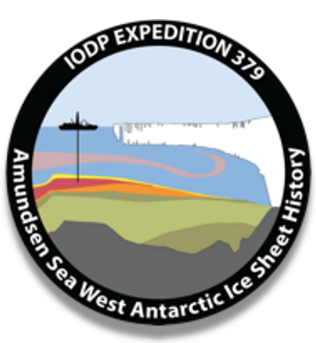


Shepherd et al 2018

Siddoway 2020



Paxman et al 2019



IODP379, 2019

GY400 is a Collaborative Research Workshop and Seminar that entails collaborative student-faculty investigation of a contemporary problem that is best examined through integration across multiple earth science disciplines. The 2020 offering will examine *Expansions and retreats of the West Antarctic Ice Sheet: Bedrock factors, ice dynamics, paleoclimate, and consequences for sea-level* . The time intervals of interest fall within the span of 34 Ma to present.

Links to: **Course Philosophy / Learning Goals (https://canvas.coloradocollege.edu/courses/31345/pages/gy400-course-philosophy-and-objective)** | **Syllabus (https://canvas.coloradocollege.edu/courses/31345/pages/2020-gy400-schedule-and-syllabus/)** | **Assignments (https://canvas.coloradocollege.edu/courses/31345/assignments)**

The course satisfies the capstone requirement for seniors, and senior standing in geology or consent of instructor (COI) is required. Enrollment is limited to 15 students. Faculty: Christine Siddoway and Trevor Hillebrand (one-block faculty visitor, Los Alamos National Lab).

An area of intense scientific interest and investigation, in this decade, is the geological and cryosphere record of expansions and retreats of the West Antarctic Ice Sheet (WAIS). Diverse disciplinary viewpoints and methods, and scientific collaboration, are critical for genuine new progress to be achieved. Bedrock factors, geo/thermochronology, ice dynamics, paleoclimate, and records/models of sea-level fluctuation all contribute to an integrated view of the continental ice sheet over a number of time scales. The adage “the past is the key to the future” is much-repeated by Antarctic scientists (including the two GY400 faculty), in this time of rapid glaciological change of WAIS, and the international Antarctic community is highly motivated to obtain records and do science that brings predictive power to the global changes ahead.

The West Antarctic Ice Sheet (WAIS) may undergo rapid dynamic collapse in a warming climate, raising global sea levels by >3 m over centuries to millennia. Some ice sheet models and paleoclimate proxies, together with geological evidence, indicate this occurred commonly in past climates similar to today’s. However, the climate thresholds of WAIS collapse remain unknown. In this class, we will review the current state of the ice sheet and examine a variety of sources of evidence for glacial-interglacial cycles (continental bedrock to deep sea cores). We will explore ice dynamics and the theoretical basis for ice-sheet instability, use geological evidence to determine rates of change, and evaluate model predictions of future WAIS retreat.

Students in the course will undertake primary investigations/original new work in two areas: 1) **isotope analyses and noble gas dating of ice rafted debris from deep sea sediment cores (https://canvas.coloradocollege.edu/courses/31345/pages/iodp379-resources-and-background)** , to ascertain the likely time of origin of the WAIS and the times of vigorous ice-sheet incision into bedrock. This component of work will be achieved through a geo/thermochronology workshop at University of Arizona, that allows direct use of instrumentation and analytical facilities at UA. 2) **Numerical model experiments (https://www.geo.umass.edu/climate/gcm2.html)** using a state-of-the-art ice sheet model designed for paleoclimate applications. Computations will be run on two clusters of four dedicated workstations in the Tutt Geospatial Commons. Working collaboratively, class members will integrate results of the two types of analysis and experimentation. The objective will be to interpret the thermochronological and numerical modeling results in terms of variations in WAIS extent and stability at selected intervals from the Oligocene to Present, informed by advanced models / the state of knowledge of the contemporary WAIS. Possible products are a new time line for the cycles of expansion and waning of the West Antarctic ice sheet, and a new understanding of the variations in the spatial extent of the WAIS between 'full glacial' and interglacial times.