Tropical seas are floored with various types of calcium-carbonate grains produced directly in seawater by biological and chemical processes. Among these grains, ooids are one-of-a-kind, as they are tiny spheres up to 2 mm in diameter and comprise one or more concentric laminae precipitated around a nucleus in shallow, turbulent water. Ooids can be found in strata of almost any geologic age. They serve as valuable sources of information regarding changes in paleoceanography and circulation patterns, oceanic Mg/Ca ratios, atmospheric pCO_2 levels, paleodepositional setting, and even plate tectonics. Ooids are formed by the activity of tides and waves, the latter being poorly understood in terms of hydrodynamics and formative mechanisms. This study will examine modern wave-generated ooids and associated sediments of the Mujeres shelf of Quintana Roo in the northeast Yucatan Peninsula, Mexico, to better understand wave-dominated ooid shelf systems as such. The fundamental rationale behind this research is that the sediment composition and seafloor morphology reflect specific hydrodynamic conditions of the ambient water. Accordingly, by recognizing a similar composition of the rock and the same morphology, geologists may infer about similar paleo-conditions in the ancient sea.

The planned research activities include: 1) collecting sediment samples from the seabottom by snorkeling and use of scuba; 2) measuring direction and speed of currents and waves with various current meters, in order to link bottom composition to hydrodynamic conditions; 3) analyzing grain size, type, and sorting using optical and scanning electron microscopes, in order to better characterize sediments across the studied shelf; 4) measuring the age of ooid with radiocarbon, which will inform when and where exactly ooids were formed and how they spread across the shelf; 5) integrating the obtained data into a GIS and generating bathymetric and thematic maps; 6) comparing recent high-resolution satellite images with older ones, to assess decadal-scale changes of the seascape; and 7) building and running hydrodynamic and sediment transport computer models to test the conceptual model obtained from the data.

Description of the ooid shelf at Quintana Roo in Mexico and its comparison with other analogic areas will help better understand and predict development of wave-affected ooid systems worldwide. Subsequently, contrasting the obtained results with those from tide-dominated ooid systems will help defining criteria for recognition of the two ooid systems in the geological past. This will improve our understanding of the fundamental controls on tropical seas, how to accurately interpret their geological analogs, and how to predict the distribution and character of sediment types away from the known data points. These are fundamental problems of modern sedimentology, as ancient ooid systems are characterized by high porosity and thus are one of the main reservoirs for mineral, hydrocarbon, and water resources as well as potential places of CO_2 sequestration.