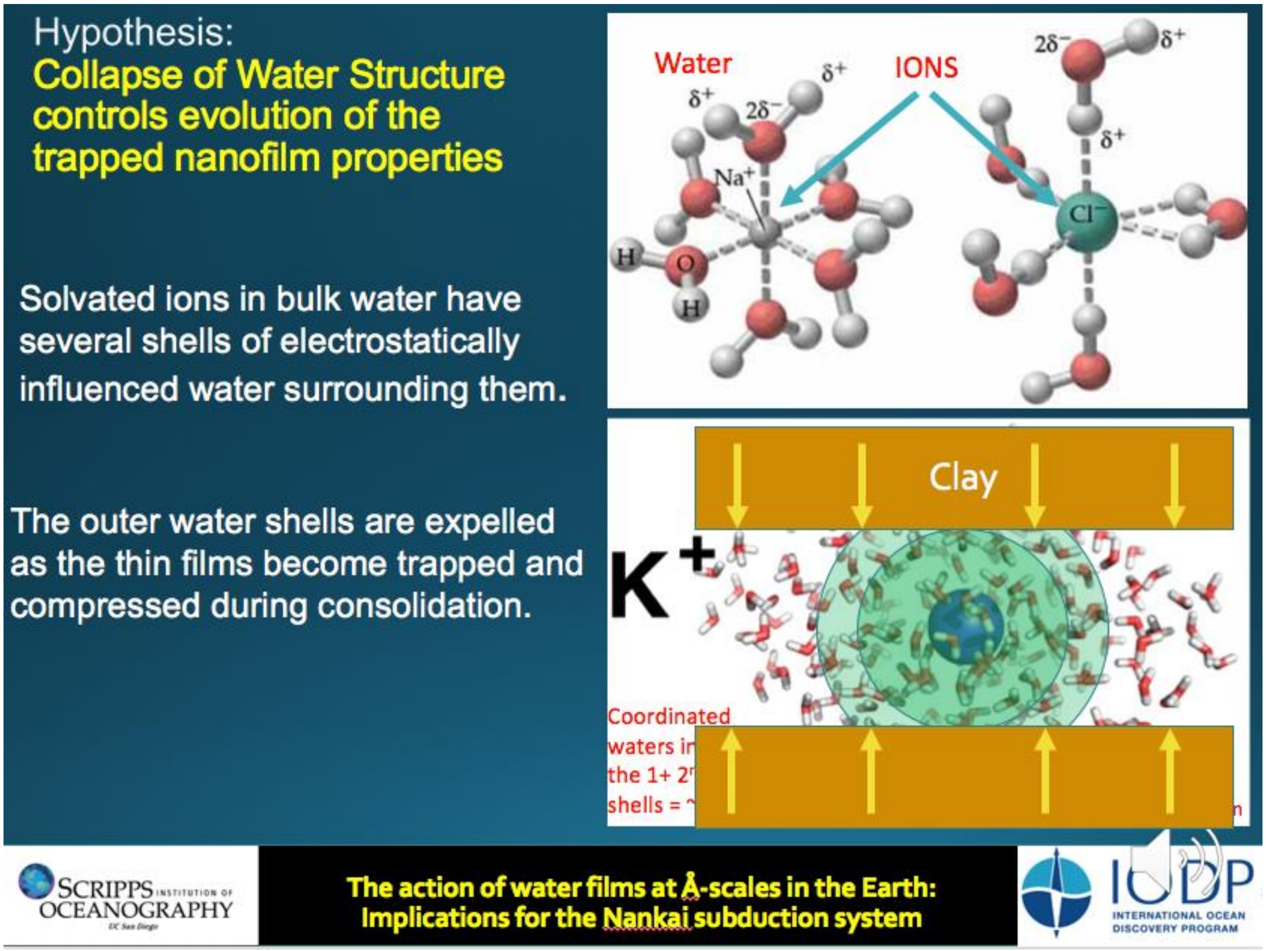
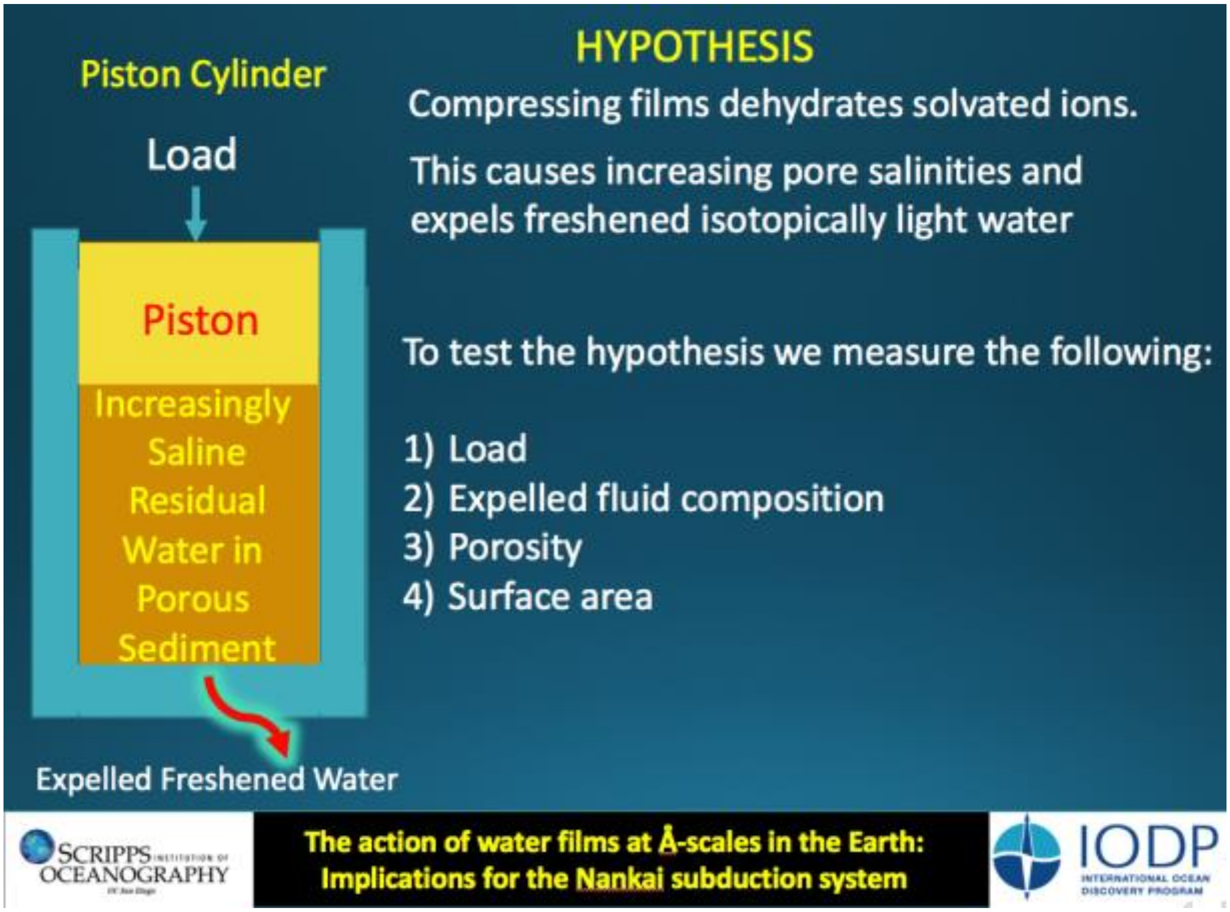
Nanofilms - Contact and Hydrologic Properties of Thin Film Pores



A current project includes understanding the interaction between actively deforming porous systems and fluids: These studies are mostly undertaken from a physical standpoint with a notable recent divergences into the semipermeable properties of thin-film pores and the evolution in permeability and chemistry in ultratight deep clay rich formations (Figs. 1 and 2).Such formations are prelevent in many deep basin and subduction settings and are involved in setting the chemistry, fluid pressure, state of stress, and frictional properties of earthquake faults. The new piston cylinder systems can compact formations to stresses of 200 MPa and 200° C and we can simultaneously measure compaction and permeability together with the fluid chemistry of the expelled fluids.

- 
Piston Cylinder
Load
Piston
Increasingly Saline Residual Water in Porous Sediment
Expelled Freshened Water
HYPOTHESIS
Compressing films dehydrates solvated ions.
This causes increasing pore salinities and expels freshened isotopically light water
To test the hypothesis we measure the following:
1) Load
2) Expelled fluid composition
3) Porosity
4) Surface area
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The action of water films at Å-scales in the Earth: Implications for the Nankai subduction system
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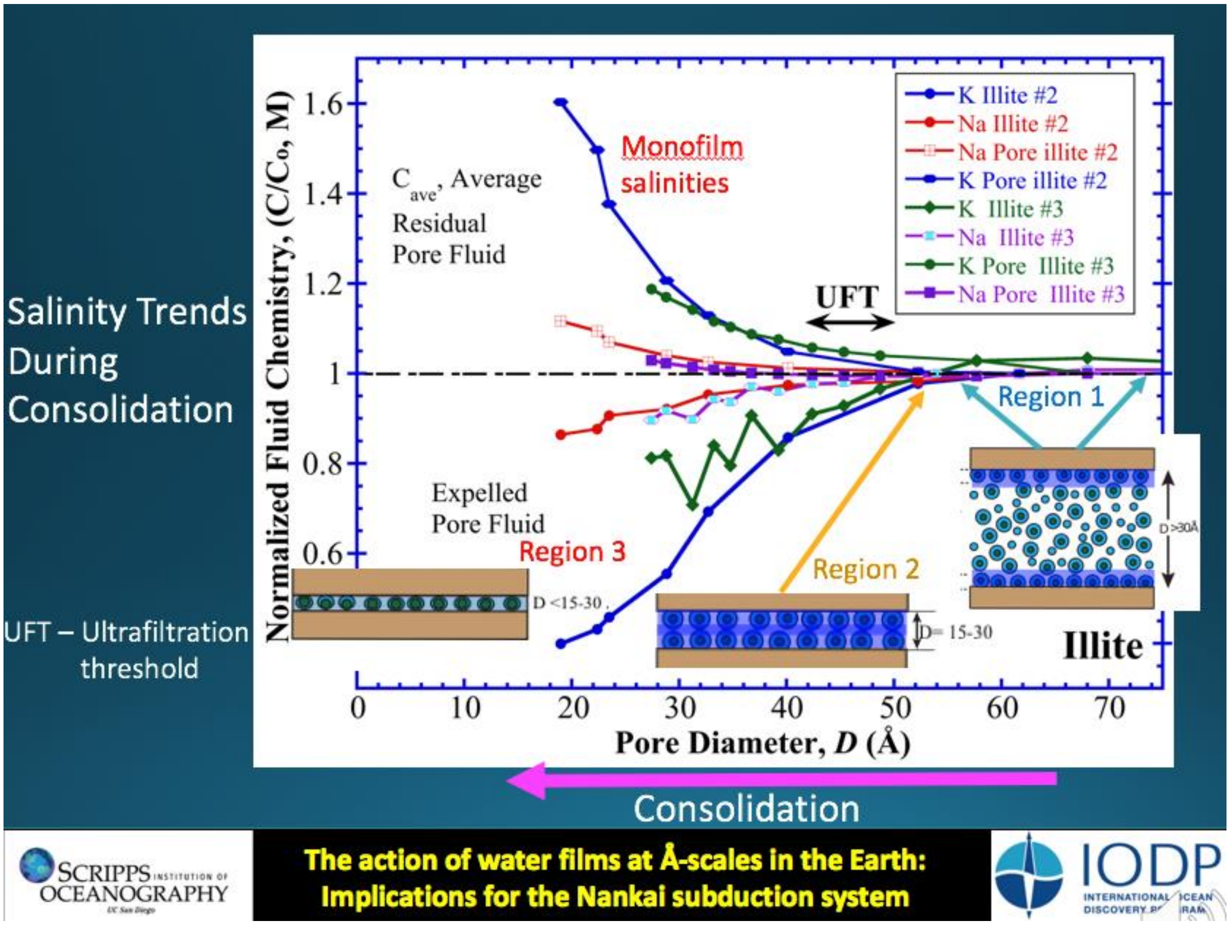
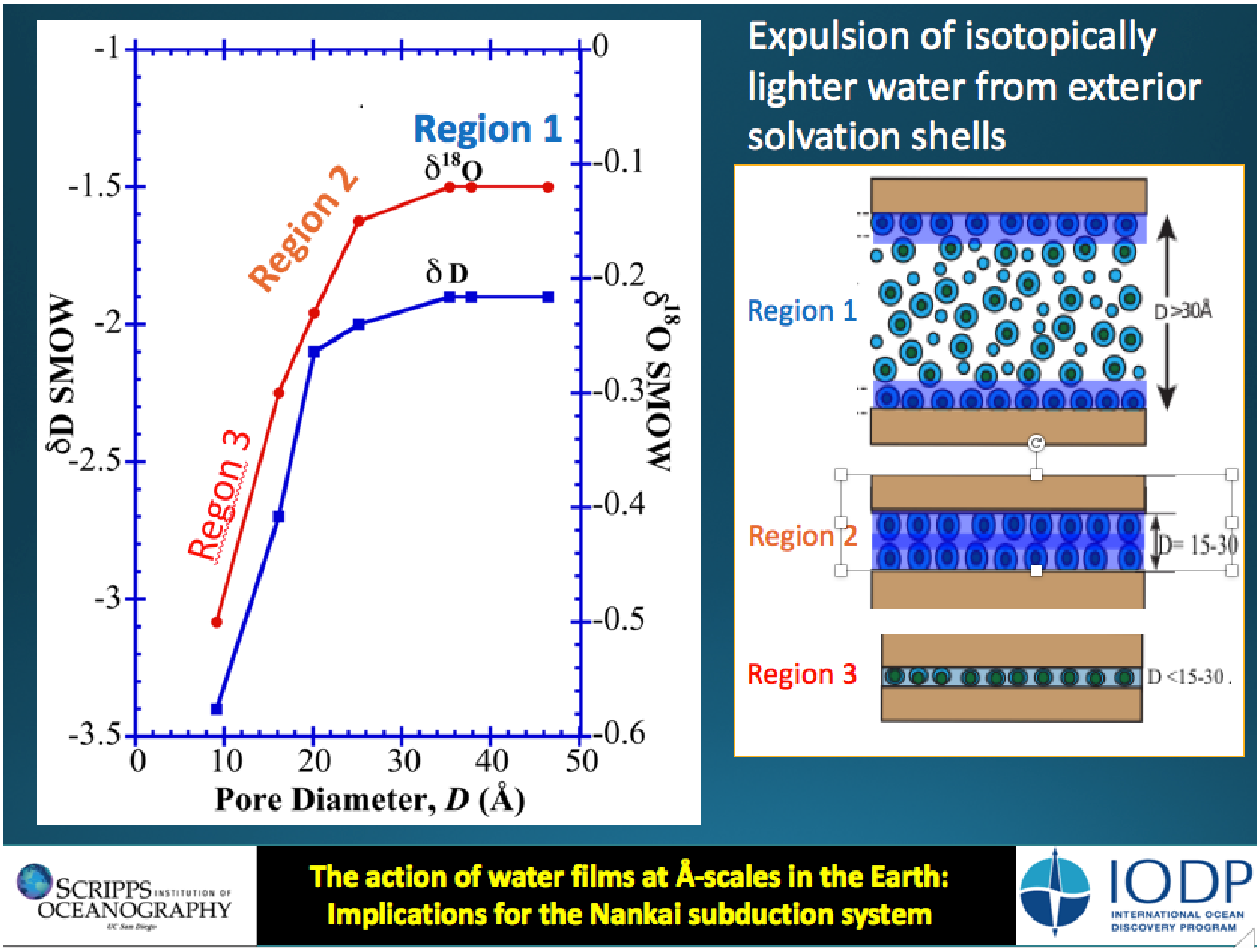
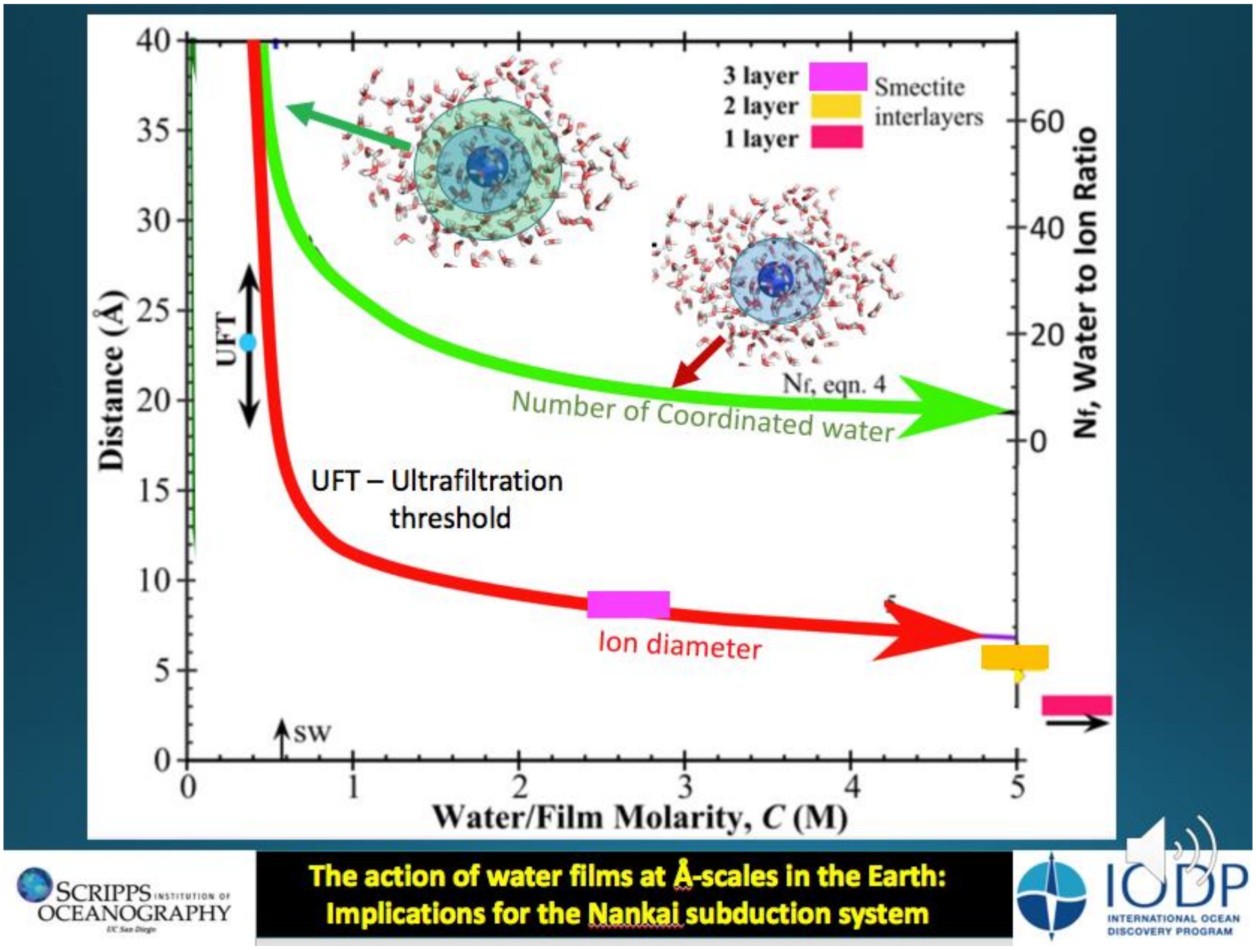


Illite fluid chemistry data from laboratory consolidation tests. Residual pore fluids increase in salinity and expelled fluids freshen as consolidation proceeds past the ultrafiltration threshold (UFT). C_o is the initial fluid composition (Scripps Inst. Oceanography (SIO) Sea water); C is the fluid composition measured at each step of pore water extraction process.



Isotopic analysis of expelled water from the 1D consolidation test (USGS at San Diego). Isotopically light fluids are expelled and heavy water is retained in the pore.



The pore thickness becomes coupled to the ion diameter the ion hydration state and the pore salinity as the pore diameter falls below one to two monolayers

The deeper regions of the Nankai Subduction system should be occupied by saline, overpressured, isotopically heavy fluid occupying pore spaces <20Å in thickness. The elevated pore pressures imply low stresses on a weak subduction thrust