Soliton solutions of the KP equation have been studied since 1970, when Kadomtsev and Petviashvili proposed a two-dimensional nonlinear dispersive wave equation now known as the KP equation. It is well-known that one can use the Wronskian method to construct a soliton solution to the KP equation from each point of the real Grassmannian.

I’ll explain how a Deodhar-type stratification of the real Grassmannian allows us to characterize the patterns that appear in these soliton solutions. These patterns can be described using the combinatorics of tableaux, triangulations, permutations, reduced expressions, Go-diagrams, etc. By using these combinatorial tools together with ingredients from total positivity, we are able to solve the inverse problem and the regularity problem for KP solitons from the real Grassmannian.

Regular KP soliton solutions provide a good model for shallow water waves (like beach waves), and I’ll end the talk with some pictures. This is joint work with Yuji Kodama. (Received December 10, 2011)