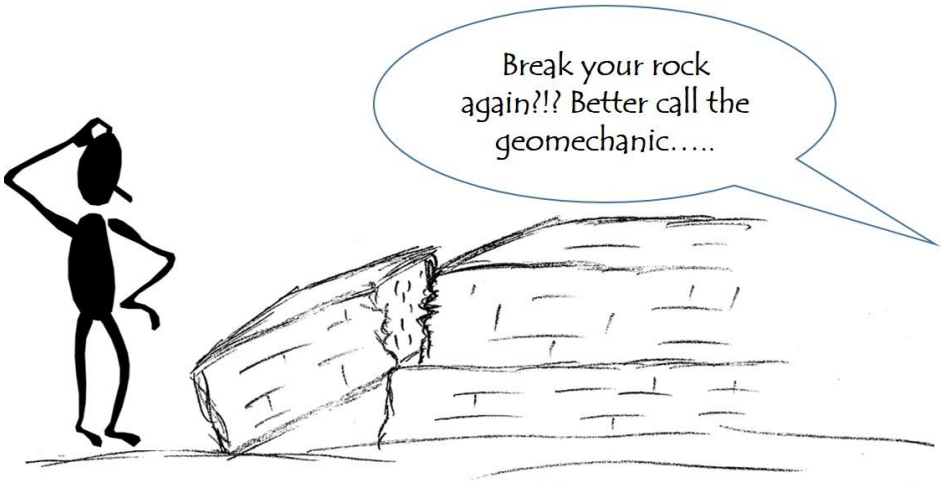
ge-o-me-chan-ics

A better explanation…..

I'm a simple kind of guy (my kids would say "old and simple", but I'll save that discussion for another post) and tend to think that a shared understanding and meaning of concepts and words is important. Take the word "geomechanics" for example. Geomechanics is a fairly common word used in the discussion of the development of Unconventional Shale reservoirs. Many folks talk about the importance of geomechanics, or doing geomechanics, or understanding the geomechanics...but do they mean the same thing? And if so, what do they mean?



I've taught geomechanics for the better part of 30 years being first a graduate teaching assistant in University (the University of Missouri-Rolla, UMR), then an assistant professor of mining engineering, then teaching geomechanics in a large oil company, and now teaching geomechanics in my own consulting company. I cannot truthfully recall, from the thousands of students or course attendees I've asked, if any had a firm understanding of what geomechanics is (at least prior to the course; afterwards ????). Oh, many nibbled around the edges a bit, but I don't recall a succinct answer that captured the importance of geomechanics, or why someone

might do geomechanics, or even why someone would want to understand the geomechanics. So...I've been teaching it for 30 plus years and figured I'd give my definition a go.

I could regurgitate the textbook definitions for geomechanics from the likes of Jaeger and Cook, Goodman, Fjaer, et al., Brady, or even from Obert and Duvall (my first geomechanics textbook taught by the late Charles Haas at UMR). I could also reopen the internecine battle over "geomechanics" verus "rock mechanics". I will do neither, because I'm not convinced that these really get us where we want to go.

At the great risk of being considered pedantic - while at the same time attempting to achieve a man-on-the-street level of definition (i.e., one in which, for example, the concepts of triple numerical integration are expressly excluded) - ***I have come to define geomechanics "as the engineering evaluation or understanding of the interplay between earth stresses, pressures, mechanical properties, and the geometry they act upon".***

The "engineering" part of my definition should be straightforward. The evaluation of mechanics (as in geo-mechanics) is traditionally and commonly understood to involve engineering. The "geo" part of geomechanics is embodied in the consideration of the four components of: 1) earth stresses; 2) pressures (properly earth pressures - whether pore pressures or pressure in other features like natural fractures); 3) mechanical properties (properly the mechanical properties and failure behavior of earth formations consisting of rock and/or soil); and 4) geometry (where geometry simply represents the surface or point or volume over which stress, pressure, and mechanical properties are acting and will be evaluated). In my experience, the geometry component can often be the most important of the four components of geomechanics. I have, for example, lost count of the number of times I've tried to explain that something as common as breakdown pressure during a stimulation is not an intrinsic property of the formation but is dominated by the geometry of the wellbore (openhole vs. cased, sleeves vs. perforations, etc.).

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Again, at the risk of being pedantic, *earth stress evaluation is not, by itself, geomechanics*. Stress is one of the four cornerstones of geomechanics, but you cannot understand or evaluate geomechanics solely with stress data. As with stress, *the evaluation and prediction of pore pressure is not geomechanics*. Again, pressure is a cornerstone of geomechanics, but one could not undertake a geomechanics investigation solely with pressure data. And this is not to ignore that, commonly, geomechanics concepts are used to evaluate and determine stress and pressure values.

Similarly, the same holds true for mechanical properties and geometry evaluations - they, by themselves, are not geomechanics. *The critical point is that geomechanics, as I have defined it, consists of the evaluation of the four cornerstone elements together and that the evaluation, determination, acquisition or consideration of the individual elements by themselves cannot and should not be considered to be geomechanics*. Simply, I am not "doing" geomechanics if I generate a stress log. I am not "understanding" the geomechanics simply by having the lab crush a few core plugs.

Why the distinction? Largely, the importance relates to avoiding confusion; confusion over data specifications, confusions over deliverables, confusion over capabilities, and so on. A good rock mechanics lab program can, for example, provide critical information as to the elastic and failure behavior of important formations for drilling and completions. However, a table of core-based elastic parameters is well short of the necessary input to evaluate geomechanical wellbore stability. Likewise, an elastic inversion may provide useful information for elastic mechanical properties and, perhaps, pore pressure, but this data is insufficient to construct and run a 3D geomechanical simulation.

Final thoughts - I have not included temperature as a cornerstone to geomechanics because I see temperature as a modifier when stress, pressure, and mechanical properties are evaluated. Further, for many common oilfield geomechanics evaluations, temperature effects can and are ignored.

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