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Creep/swelling behavior of shale/clay: Discrete element modeling, based on Monte-Carlo technique

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Creep/swelling of Shale-rocks create several problems [1] during underground drilling operations, such as stuck-pipe/drill-bit. However, creep/swelling of shale-rocks can close the gaps between rock (wellbore) and casing –therefore no cementing is needed –which can save a lot of time and money and such a "natural"closing ensures "no-leakage"during further drilling and production phases. The field experience reveals that some shale-rocks are good candidate for creep/swelling and some are not. There are several parameters influence the creep/swelling behavior, such as- porosity, clay-quartz contents, stress difference between field and drilling zone etc. Therefore, to plan a safe and efficient drilling operation through shale-rocks, we should understand the creep/swelling mechanism of shale/clay. In this work, we have introduced a discrete element model, based on Monte-Carlo technique. We define a probability of swelling for all the clay grains in the shale-rock sample that includes the effect of stress-difference, porosity, temperature etc. The time evolution of grain creep/swelling results in bulk creep/swelling behavior of the sample and the simulation result qualitatively matches with the observations of shale/clay swelling experiments [2,3].

References

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