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Advancing sandstone reservoir compressibility prediction: A correlation-driven methodology
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Abstract
This study presents a correlation-based approach for predicting the compressibility of sandstone reservoir rocks. The study proposes a matrix of new empirical equations that significantly improve the precision of measuring the pore volume compressibility, with the most optimal fit of results based on a cubic polynomial model. The accuracy of the calculations was validated through comparison with actual data using root mean square method, and the suggested correlations significantly enhance the precise prediction of rock compressibility in sandstone reservoirs. In this study, the source of data collection is consolidated and unconsolidated sandstone from East Asia offshore oilfields. Accordingly, variations in compressibility with net overburden pressure over the course of the field's lifespan have been examined. The results demonstrate the application of regression analysis in establishing a network of linkages between independent and dependent variables. The proposed correlations for consolidated and unconsolidated sandstones offer a remarkable improvement in the accurate calculation of rock compressibility compared to traditional laboratory procedures, with an average error of 2.5% compared to 5–10% for laboratory measurements. The approach of this study offers a cost-effective and time-efficient alternative to remarkedly enhance the overall performance of sandstone reservoirs in the oil and gas industry.

Author Keywords
Compressibility; Consolidated and unconsolidated sandstone; Rock mechanics; Rock properties

Index Keywords
Compressibility, Cost effectiveness, Forecasting, Gas industry, Offshore oil well production, Regression analysis, Rock mechanics; Consolidated and unconsolidated sandstone, Cubic polynomials, Empirical equations, matrix, Pore-volume compressibility, Reservoir compressibility, Reservoir rock, Rock compressibility, Rock properties, Sandstones reservoirs; Sandstone

References

- Ahmed, T.
  Chapter 4 - fundamentals of rock properties
  (2010) *Reservoir Engineering Handbook*, pp. 189-287.
  T. Ahmed fourth ed. Gulf Professional Publishing Boston

- Ashena, R., Behrenbruch, P.
  Development of rock compressibility relationships for Middle eastern carbonate and sandstone reservoirs
  (2020) *SPE Asia Pacific Oil & Gas Conference and Exhibition*,

- Behrenbruch, P., Ashena, R.
  Integrated workflow for rock compressibility modeling and analysis of laboratory core data
  (2023) *SPE J.*, 28 (3), pp. 1149-1164.

- Biot, M.A.
  General theory of three-dimensional consolidation
  (2004) *J. Appl. Phys.*, 12 (2), pp. 155-164.

- Carpenter, C.B., Spencer, G.B., United, S.
  Measurements of Compressibility of Consolidated Oil-Bearing Sandstones
  (1940), United States Department of the Interior, Bureau of Mines Washington, DC

- Fatt, I.
  Pore volume compressibilities of sandstone reservoir rocks
  (1958) *J. Petrol. Technol.*, 10 (3), pp. 64-66.

- Floxlab.

- Geertsma, J.
  Problems of Rock Mechanics in Petroleum Production Engineering
  (1966), 1st ISRM Congress OnePetro

- Hall, H.N.
  Compressibility of reservoir rocks
  (1953) *J. Petrol. Technol.*, 5 (1), pp. 17-19.

- Horne, R.N.
  (1995) *Modern Well Test Analysis*, 926.
  Petroway Inc

- Jalalh, A.A.
  Compressibility of porous rocks: Part II. New relationships
  (2006) *Acta Geophys.*, 54 (4), p. 399.

- Khosravi, V., Mahmood, S.M., Sharifigaliuk, H., Zivar, D.
  A systematic study of Smart Water technology in improving the reservoir recovery performance
  (2022) *J. Petrol. Sci. Eng.*, 216.

- Li, C., Chen, X., Du, Z.
  A new relationship of rock compressibility with porosity
  (2004) *SPE Asia Pacific Oil and Gas Conference and Exhibition*,

- Macini, P., Mesini, W.
  Static and dynamic reservoir rock compressibility at high pressure
  (1998) *SPE Abu Dhabi International Petroleum Exhibition and Conference*,

- Marchina, P., Brousse, A., Fontaine, J., Dano, C., Alonso, C.
  In-situ measurement of rock compressibility in a heavy oil Reservoir
  (2004) *SPE International Thermal Operations and Heavy Oil Symposium and Western Regional Meeting*,

- Newman, G.H.
  Pore-volume compressibility of consolidated, friable, and unconsolidated reservoir rocks under hydrostatic loading
  (1973) *J. Petrol. Technol.*, 25 (2), pp. 129-134.

- Pimienta, L., Fortin, J., Guéguen, Y.
New method for measuring compressibility and poroelasticity coefficients in porous and permeable rocks
(2017) *J. Geophys. Res. Solid Earth*, 122 (4), pp. 2670-2689.

- Poston, S., Chen, H.
The simultaneous determination of formation compressibility and gas-in-place in abnormally pressured reservoirs
(1987) *SPE Production Operations Symposium*,

- Qmineral.

- Suman, A.
Uncertainties in Rock Pore Compressibility and Effects on Seismic History Matching
(2009), Stanford University

- Terzaghi, K.V.
The shearing resistance of saturated soils and the angle between the planes of shear
(1936) *First International Conference on Soil Mechanics*,

- Tiab, D., Donaldson, E.E.
Chapter 9 - Effect of Stress on Reservoir Rock Properties
(2016) *Petrophysics*, pp. 483-582.
D. Tiab E.C. Donaldson fourth ed. Gulf Professional Publishing Boston

- Yildiz, T.
Prediction of in-situ formation compressibility from production data
(1998) *SPE/ISRM Rock Mechanics in Petroleum Engineering*,

- Zimmerman, R.W., Somerton, W.H., King, M.S.
Compressibility of porous rocks
(1986) *J. Geophys. Res. Solid Earth*, 91 (B12), pp. 12765-12777.

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