

STUDI PERUBAHAN STRUKTUR PORI DAN REKAHAN 3D  
PADA BATUAN PENUDUNG PANAS BUMI AKIBAT PENGARUH  
TEKANAN *UNIAXIAL* SERTA KEAMANAN *CLAY CAP* DAERAH  
PANAS BUMI CANDI UMBUL-TELOMOYO, SEMARANG

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SUMARNI

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**ABSTRAK**

Potensi panas bumi Candi Umbul-Telomoyo sangat menarik untuk diteliti karena kemunculan manifestasi panas bumi. Sampel batuan penudung dari daerah panas bumi Candi Umbul-Telomoyo, Semarang yang telah dianalisis untuk diketahui perubahan struktur pori dan rekahan 3D akibat pengaruh tekanan *uniaxial*. Struktur pori dan rekahan 3D dianalisis menggunakan metode *Digital Image Processing and Analysis*. Sampel yang digunakan berupa batuan breksi andesit terubah yang berbentuk silinder dengan ukuran diameter 4,4 cm dan tinggi 4,3 cm. Sampel batuan diambil dari sumur landaian suhu pada kedalaman 590 m. Sampel batuan diberikan perlakuan tekanan *uniaxial* mulai dari 59 bar, 75 bar, 91 bar, 107 bar, 123 bar dan 156 bar. Hasil yang diperoleh menunjukkan adanya perubahan struktur pori dan rekahan selama peningkatan tekanan. Besaran fisis yang diperoleh sebagai fungsi tekanan, baik parameter rekahan [total orientasi  $\{\theta(P)\}$  bersifat polinomial, *aperture*  $\{e(P)\}$  bersifat linear, densitas  $\{\Phi(P)\}$  bersifat eksponensial, dan intensitas  $\{I(P)\}$  bersifat polinomial] dan porositas struktur pori  $\{\phi(P)\}$  bersifat power dengan pemberian tekanan sampel menjadi bersifat *impermeable*. Dimensi fraktal mengalami perubahan mikrostruktur pori selama peningkatan tekanan. Peningkatan tekanan dapat mempengaruhi keamanan *clay cap* panas bumi dengan pengujian kuat tekan *uniaxial* dapat diketahui kekuatan sampel batuan ini dan sampel batuan pecah pada tekanan 214 bar. Hasil penelitian ini diharapkan dapat memberikan gambaran tentang karakteristik batuan penudung dan keamanan *clay cap* panas bumi Candi Umbul-Telomoyo.

Kata kunci: perubahan struktur pori, rekahan 3D, tekanan *uniaxial*, *clay cap*, dimensi fraktal.

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STUDY OF 3D PORE STRUCTURE AND FRACTURE FORMING  
ON GEOTHERMAL CLAY CAP ROCK DUE TO EFFECT OF  
UNIAXIAL PRESSURE AND SAFETY CLAY CAP ON  
GEOTHERMAL AREA IN CANDI UMBUL-TELOMOYO,  
SEMARANG

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**ABSTRACT**

The geothermal potential of Candi Umbul-Telomoyo is very interesting to be observed because of the emergence of geothermal manifestations. Samples of clay cap rock on geothermal area in Candi Umbul-Telomoyo, Semarang has been to see 3D pore structure change and 3D fracture development due to the influence of *uniaxial* pressure. The pore structure and 3D fracture were analyzed using Digital Image Processing method. The sample is altered ceses andesite breccia formed in diameter of 4.4 cm and height of 4.3 cm. The rock samples were collected from wells at 590 m. Rock samples were given *uniaxial* pressure treatments ranging from 59 bars, 75 bars, 91 bars, 107 bars, 123 bars and 156 bars. The results show that 3D pore structure changes and 3D fracture develops as pressure increase. The physical quantities obtained as a function of pressure, both fracture parameters (total orientation  $\{\theta (P)\}$  are polynomial, aperture  $\{e (P)\}$  is linearly increase, density  $\{\Phi (P)\}$  is exponential increase, and intensity  $\{I (P)\}$  is polynomial] while pore structure porosity  $\{\phi (P)\}$  with this ranger of pressure treatment the sample is remained impermeable. Fractal dimension 3D both 3D pore structure and fracture increases at of in ranger 59 bar until 91 bar and of may due to 3D pore formed accumulated both as increases. Increased pressure can affect the safety of clay cap geothermal by testing *uniaxial* compressive strength can be known strength of rock samples and rock samples broken at pressure of 214 bar. The results of this study are expected to provide an overview of the characteristics of the screening rock and the clay cap stability on Geothermal Area Candi-Umbul Telomoyo.

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*Keywords:* structure pore change, 3D fracture, *uniaxial* pressure, *clay cap*, fractal dimension.

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