

해양 저류층 탐지를 위한 수직 송수신기를 이용하는 시간영역 전자탐사법

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A transient EM method with vertical transmitters and receivers for offshore hydrocarbon exploration

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A frequency-domain, marine controlled-source electromagnetic (CSEM) method has been applied successfully in deep water areas for detecting hydrocarbon (HC) reservoirs. However, a typical technique with horizontal transmitters and receivers requires large source-receiver separations with respect to the target depth. A time-domain EM system with vertical transmitters and receivers can be an alternative because vertical electric fields are sensitive to deep resistive layers. In this paper, we have written a time-domain forward modeling code with multiple source and receiver dipoles that are finite in length to investigate transient EM problems. With the use of this code, we calculate step-off responses for one-dimensional (1D) HC reservoir models (Fig. 2). Although the vertical electric field has much smaller amplitude of signal than the horizontal field, vertical currents resulting from a vertical transmitter is sensitive to resistive layers. The modeling shows a significant difference between step-off responses of HC- and water-filled reservoirs, and the contrast can be recognized at late times at relatively short offsets. A maximum contrast occurs at more than 4 s, being delayed with the depth of the HC layer.

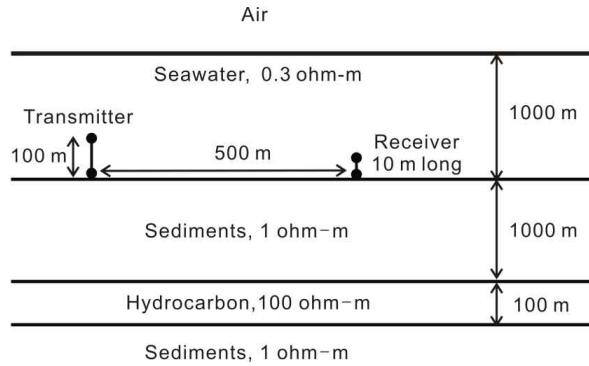


Figure 1. A 1D offshore HC reservoir model.

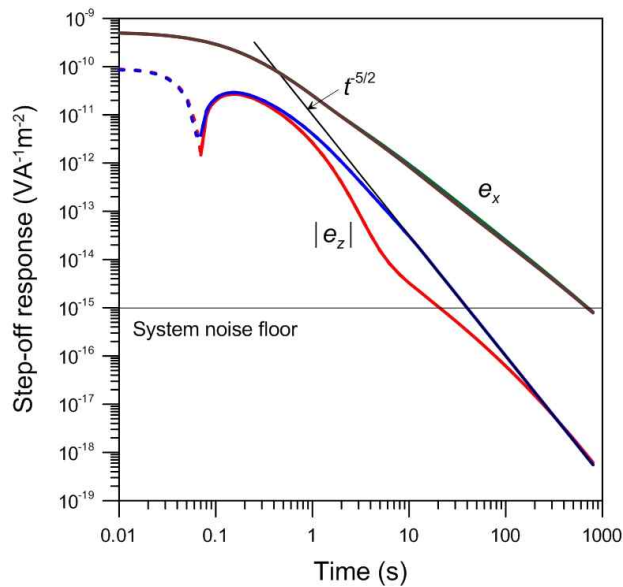


Figure 2. Vertical responses from a vertical source for the HC reservoir model (red line), and the background model (blue line), and the horizontal responses from a horizontal source for the HC reservoir model (brown line) and the background model (green line). Dashed lines indicate negative values of the response and solid lines are positive. A 10 m-long receiver is located 500 m away from a 100 m-long transmitter at the seafloor with a water depth of 1000 m. The resistive HC layer is buried at 1000 m below the seafloor.