Abstracts of Papers Appearing in *Geophysics*, Volume 49, Number 10, October 1984

D. Drahos. *Electrical modeling of the inhomogeneous invaded zone*

The ideal rock model in electrical well logging for prospecting hydrocarbon consists of three cylindrical layers characterized by homogeneous resistivities. The second layer of model represents the zone of invasion, where under real circumstances the resistivity is not constant but changes with the distance from the borehole. This condition could be taken into consideration, but the solution of the electrical direct problem for such a case is very complicated. Any kind of invasion resistivity profile can be approximated by many cylindrical layers of homogeneous resistivities. A recursive formula is derived by which the many-layer problem can be solved simply. Numerical calculations were made to study the effect of the inhomogeneity of the invaded zone. Apparent resistivities of different Laterolog and normal arrangements were calculated for several models having linearly increasing resistivity values. These were evaluated by least-squares fitting to determine the equivalent electrical parameters of the usual model of three homogeneous layers. The results show that there is practically no error in determination of the true resistivity, but the depth of invasion may be significantly smaller than that of the linear resistivity profile.

W. C. Chew, S. Barone, B. Anderson and C. Hennessy. *Diffraction of axisymmetric waves in a borehole by bed boundary discontinuities*

This paper presents the calculation of the diffraction of axisymmetric borehole waves by bed boundary discontinuities. The bed boundary is assumed to be horizontal and the inhomogeneities to be axially symmetric. In such a geometry, an axially symmetric source will produce only axially symmetric waves. Since the borehole is an open structure, the mode spectrum consists of a discrete part as well as a continuum. The scattering of a continuum of waves by bed boundaries is difficult to treat. The approach used in the past in treating this class of problem has been approximate in nature, or highly numerical, such as the finite-element method. We present here a systematic way to approximate the continuum of modes by discrete modes. After discretization, the scattering problem can be treated simply. Since the approach is systematic, it allows derivation of the solution to any desired degree of accuracy in theory; but in practice, it is limited by the computational resources available. We also show that our approach is variational and satisfies both the reciprocity theorem and energy conservation.

Leung Tsang, A. K. Chan and S. Gianzero. *Solution of the fundamental problem in resistivity logging with a hybrid method*

The fundamental resistivity logging problem of a resistivity tool in the presence of both vertical and horizontal boundaries is solved with a hybrid method. The hybrid method combines the mode concept in wave-guide theory together with the finite-element method. In the mathematical formulation, the horizontal boundaries are used to separate the geometry of the problem into different regions. In each region, the waveguide modes are obtained through the solution of an equivalent variational problem. The solutions are calculated by a one-dimensional finite-element method. The vertical boundaries are taken into account in these calculations. The orthonormality of modes in each region allows a series representation of the potential in the regions. Boundary conditions at horizontal bed boundaries then couple the modes between different regions and enable the solutions for the potential to be expressed in terms of reflection and transmission matrices of modes. The source excitation determines the amplitudes of the modes. The results of the hybrid method are in excellent agreement with those of the integral transform solution. Numerical results of the apparent resistivity are illustrated as a function of formation properties. The effects of an invaded zone are also examined by considering radial inhomogeneous profiles in the formation. The results of the hybrid method are numerically efficient because it reduces the two-dimensional finite-element problem into a one-dimensional one. It also provides a physical interpretation of the solution in terms of modes.

E. J. W. Jones, R. S. White, V. J. Hughes, D. H. Matthews and B. R. Clayton. *Crustal structure of the continental shelf off northwest Britain from two-ship seismic experiments*

Two-ship multichannel seismic profiles, using expanding spread and constant offset source–receiver configurations, were shot with explosive charges and a 16.4 l air gun to