than one CMP gather in each analysis. This extension allows proper treatment of dipping events and yields velocity information that is more appropriate for use in migration. By using the intermediate wave field at each step of downward extrapolation, we need only do a single constant-velocity migration of the unstacked data followed by a simple mapping procedure in order to recover the velocity information.

D. Messfin and W. Moon. *Seismic approaches for structural studies of the Sudbury basin*

This study investigates the feasibility of applying seismic techniques in the search for ore deposits, with particular emphasis given to locating orebodies at great depths. The basic procedure followed was essentially an understanding of the forward problem, whereby the effects of the subsurface structure in a typical mining district were thoroughly studied. The initial stage of the study was devoted to determining the elastic parameters by laboratory measurement of seismic velocities and densities of core samples obtained from the Sudbury basin, Canada. By virtue of its ability to handle lateral as well as vertical inhomogeneities, fast computing time and flexibility, the asymptotic ray theory was judged to be more suitable for studying the effect of geologic structures typically found in the Sudbury basin. Both large-scale and small-scale models, representing actual geologic conditions in Sudbury, were constructed. The computed seismic response of the large-scale models shows that the micropegmatite/oxide-rich quartz gabbro and the mafic norite/granite gneiss contacts are characterized by substantially strong reflections, indicating that these two interfaces can serve as marker horizons in future seismic surveys. In the small-scale models of mineralized structures, the sulfide body was outlined by a distinctly high amplitude of reflection. Both the traveltime and the dynamic characteristics of these models have features that are indicative of the presence of mineralized structures.

D. Fenati and F. Rocca. *Seismic Reciprocity field tests from the Italian peninsula*

The conditions for applicability of the reciprocity theorem, commonly invoked in seismic data gathering, are rarely met in usual practice. A field test was conducted in an area characterized by remarkable inhomogeneities of the surface layers to assess quantitatively the discrepancies between direct and reciprocal traces; the energy sources used were both of vibratory and impulsive type. The results show that the coherence between the two traces is good, except for the case of short offsets and early times with explosive sources. The vibratory source, even if theoretically 'more reciprocal' than the explosive one, yields coherencies in the same range, and is less uniform along the frequency axis.

W. Daily. *Underground oil-shale retort monitoring using geotomograph*

Geophysical tomographs (geotomographs) were made of two underground oil-shale retorts: (1) the Occidental Oil Shale Inc. miniretort constructed for ignition tests at the demonstration mine at Logan Wash, Colorado; and (2) the Geokinetics Oil Shale Inc. Retort 25 near Vernal, Utah. These experiments demonstrate that geotomography may be a valuable diagnostic tool for underground oil-shale retorting processes. At the Geokinetics in-situ retort, the technique delineated the zones of high permeability in a cross-section of the retort. At the Occidental modified in-situ miniretort, the technique imaged the high-temperature zone of the retort with a spatial resolution of about 2 m, and showed its temporal development over a period of eleven days.

A. C. Tripp, G. W. Hohmann and C. M. Swift Jr. *Two-dimensional resistivity inversion*

Resistivity data on a profile often must be interpreted in terms of a complex two-dimensional (2-D) model. However, trial-and-error modeling for such a case can be very difficult and frustrating. To make interpretation easier and more objective, we have developed a nonlinear inversion technique that estimates the resistivities of cells in a 2-D model of predetermined geometry, based on dipole–dipole resistivity data. Our numerical solution for the forward problem is based on the transmission-surface analogy. The partial derivatives of apparent resistivity with respect to model resistivities are equal to a simple function of the currents excited in the transmission surface by transmitters placed at receiver and transmitter sites. Thus, for the dipole–dipole array the inversion requires only one forward problem per iteration. We use the Box–Kanemasu method to stabilize the parameter step at each iteration. We have tested our inversion technique on synthetic and field data. In both cases, convergence is rapid and the method is practical if the number of parameters is not too large. The main limitations of the method are that the geometry of the model must be specified in advance, and that it is difficult to determine whether model misfit is due to 3-D effects or to underparameterization in the 2-D model. The technique should be used interactively, with models constrained by geologic information.

G. L. Oppliger. *Three-dimensional terrain corrections for mise-à-la-masse and magnetometric resistivity surveys*

Three dimensional modeling of topographic effects in mise-à-la-masse and magnetometric resistivity surveys is accomplished using the surface integral equation method. The technique provides a means for (1) analyzing these effects on earth models of homogeneous conductivity; and (2) removing terrain effects from field data. A new method combining current source images with surface charge is developed to treat the electric field boundary conditions at the air–earth interface. The method uses an image of each subsurface current source positioned above the surface, so as to induce a surface charge distribution which approximately cancels the charge distribution induced by the subsurface current source. The resulting residual surface charge distribution varies spatially more gradually than either of the original charge distributions, and hence may be represented accurately on a coarsely segmented model surface with simple basis functions. The topographic surface is modeled by a finite number of facets, each with constant slope and surface charge density. Charge values are obtained with an iterative solution technique. Surface electric fields are calculated from the surface charge distribution, current sources, and images. The magnetic field is found 'by evaluating a surface integral involving surface slopes and electric fields. The numerical solution is verified by comparisons with dipole–dipole resistivity results from a two-dimensional finite-element model of a valley, and with analytic solutions for the magnetic fields over a dipping interface. Methods for terrain correcting mise-à-la-masse and magnetometric resistivity data are demonstrated with examples using actual field measurements. The results of this study show that (1) rugged topography can significantly distort measurements in mise-à-la-masse and magnetometric resistivity surveys; and (2) the described modeling technique provides an effective means of calculating terrain corrections for both the mise-à-la-masse and magnetometric resistivity methods over complex three-dimensional topography.

R. P. Ranaganayaki. *An interpretive analysis of magnetotelluric data*

A simple analysis to determine the dimensionality of magnetotelluric resistivity variations, to separate the near-surface resistivity variation from the variations at depth, and to find the relative resistivity variations with depth is described. Parameters derived from the magnetotelluric impedance tensor are mapped in pseudo-section and planar view for two-dimensional (2-D) model data and for survey data from Montana. These data illustrate procedures that can qualitatively map complex resistivity structures in the lateral distance-frequency domain or, equivalently, the lateral distance-scaled vertical distance domain. Phase-dependent parameters have better vertical resolution than parameters related to scalar apparent resistivity, but the latter allow estimates of the resistivities encountered. Phase parameters for the Montana data provide a semiquantitatively accurate cross-section of a geologically known anticlinal structure. This suggests a means of subsurface structural mapping with magnetotelluric data. The use of these parameters with sufficiently dense and accurate data provides a first-order indication of structure for subsequent quantitative modeling.

Y. Murakami. *Analysis of equivalence for the Schlumberger resistivity methods using the RHO-*R *and RHO-*C *curves in the resistivity transform domain*

The problem of equivalence in the resistivity methods is studied in the resistivity transform domain. The RHO-*R* and RHO-*C* curves, which are, respectively, determined by the transverse resistance and longitudinal conductance, are shown to define the asymptotes of the resistivity transform curve. Models which give almost identical asymptotes also give almost identical resistivity transform curves. Thus, equivalent models can be found by obtaining models which do not change the shape of these asymptotes. For a given layered model, a plot of the RHO-*R*, RHO-*C*, and resistivity transform curves graphically shows the range of equivalence of the model. Equivalent models can be obtained by changing either resistivity, thickness, or depth of the given model through a simple graphical procedure.

W. L. Anderson. *Computation of Green's tensor integrals for three-dimensional electromagnetic problems using fast Hankel transforms*

A new method is presented that rapidly evaluates the many Green's tensor integrals encountered in three-dimensional electromagnetic modeling using an integral equation. Application of a fast Hankel transform (FHT) algorithm (Anderson 1982) is the basis for the new solution, where efficient and accurate computation of Hankel transforms are obtained by related and lagged convolutions (linear digital filtering). The FHT algorithm is briefly reviewed and compared to earlier convolution algorithms written by the author. The homogeneous and layered half-space cases for the Green's tensor integrals are presented in a form so that the FHT can be easily applied in practice. Computer timing runs comparing the FHT to conventional direct convolution methods are discussed, where the FHT's performance was about 6 times faster for a homogeneous half-space, and about 108 times faster for a five-layer half-space. Subsequent interpolation after the FHT is called is required to compute specific values of the tensor integrals at selected transform arguments; however, due to the relatively small lagged convolution interval used (same as the digital filter's), a simple and fast interpolation is sufficient (e.g. by cubic splines).

J. Korringa. *The influence of pore geometry on the dielectric dispersion of clean sandstones*

In an idealized description a clean sandstone is an isotropic two-component medium consisting of a solid with dielectric constant ϵ_1 and a pore fluid (brine) with dielectric constant ϵ_2 and conductivity σ_2. On the basis of D. Bergman's work [*Ann. Phys.* 138, 78 (1982)] the dielectric response of such a medium is expressed in terms of the dc conductivity and of a real, positive and bounded function, defined in <1, 0> and independent of ϵ_1, ϵ_2, and σ_2. This function is restricted by three relations which express weighted averages of it in terms of the asymptotic value of the dielectric response at high frequency, the porosity, and the dc conductivity. The formalism is exact for two-component media of the type specified. It supplements an approximate treatment by Lysne (1983) and can, without much difficulty, be generalized to any isotropic two-component composites.

S. A. Arcone. *Field observations of electromagnetic pulse propagation in dielectric slabs*

The propagation of electromagnetic pulses in naturally occurring dielectric surface layers has been examined. Pulse duration used in field experiments reported here has been on the order of nanoseconds with pulse bandwidths in the high VHF to low UHF band. The layers were sheets of fresh water ice and granite at thicknesses ranging between 0.4 and 4 m. Both transverse electric (TE) and transverse magnetic (TM) modes were attempted but only the TE propagation could be interpreted. Analog recordings of wide-angle reflection and refraction (WARR) profiles were taken and recorded in a continuous graphic display. The displays allowed easy identification of phase fronts thereby facilitating study of the dispersion of the pulses. The phase and group velocities of the wave-group packets agree well with the velocities