ally be too large so 0 will be too large. If 0 is too large then R_w will also be too large where rocks are altered or when there is cycle skipping. Therefore, the minimum envelope of the R_w curve will establish the correct value of R_w. Once we have established this minimum, or correct R_w trend, we can compute a corrected traveltime curve using it and the resistivity log in equation (4). As long as the rocks are pure shale, the above calculation is adequate. However, if there is another lithology such as sand in the system, we must calculate another R_w in the sand zones and use it when the lithology logs tell us we are in sand. Now we have two R_w values. R_{wsh} is for pure shale and R_{wsd} is for clean sand. If there is a mixture of shale and sand, then we must calculate R_{mix}:

$$R_{mix} = 1/((V_{sh}/R_{wsh}) + ((1 - V_{sh})/R_{wsd})) \qquad (6)$$

Substituting R_{mix} for R_w in traveltime/resistivity equation (6), we have a continuously corrected traveltime curve with changes in lithology adequately taken care of:

$$t = 55.5 + 133.5 * (R_{mix}/R_0)^{.5}. \qquad (7)$$

A similar rationale may be used in other combinations of lithology and also for the density log. For the density log equation (7) becomes

$$P_b = 2.65 - 1.65*(R_{mix}/R_0)^{.5}. \qquad (8)$$

In a limestone environment, equations (7) and (8) become

$$t = 47.5 + 141.5*(R_{mix}/R_0)^{.5}, \qquad (9)$$

and

$$P_b = 2.71 - 1.71*(R_{mix}/R_0)^{.5}. \qquad (10)$$

After picking the R_w envelope for shales and nonshales, we combine these with a computation of V_{sh}, and create a continuous computation of R_{mix} which varies with the relative amounts of shale and nonshale. V_{sh} is calculated from the GR, or SP, or both. If both are used, the minimum V_{sh} is usually chosen. Other shale responsive logs such as the density or neutron could be used for V_{sh} if necessary.

The R_{mix} computation is combined with the resistivity log (R_0) in equations (7), (8), (9), or (10) to arrive at t or P_b. Note that the R_w calcluations will be different for different lithologies. R_w will not necessarily be a true formation water resistivity. For these purposes it should be considered as a correlation factor only. Figure 1 shows single synthetic traces spliced into a seismic section at the appropriate shotpoint. The leftmost synthetic trace is derived from the original Sonic log. The trace on the right is from the resistivity edited log. Note that not just the times are in error on the unedited version; there are many spurious reflections on the trace as well. These are from the large and erratic traveltime anomalies caused by the rock alteration near the well bore. Once the R_w correlations are determined for a zone they can be extrapolated horizontally as well as vertically. This permits generation of synthetic acoustic and density in wells not having this information available. Synthetic seismograms from these resistivity derived acoustic logs provide reasonable time/depth correlations. These "synthetic, synthetic" seismograms are very useful in areas having many older wells without adequate logs.

Conclusions

1) A large percentage of wells logged before the advent of the long spacing Sonic tool have poor quality acoustic log information through most of the shale sections. This poor quality data creates poor quality synthetic seismograms.
2) Resistivity, gamma ray, caliper, and SP logs can usually provide substitute or recreated acoustic and density data for better synthetic seismograms.
3) Stastical correlations between resistivity and acoustic logs are often poor because the major causes of acoustic/seismic mismatch are not statistical—they are unidirectional.
4) Correlation of R_w information permits derivation of synthetic acoustic and density logs in old wells not having this data.

OPDS: The Ontario Petroleum Data System — BHG 4.7

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OPDS is a computerized system for the acquisition, storage, retrieval, and processing of oil and gas well data, developed for the Ontario Ministry of Natural Resources by Dataplotting Services Inc. Computerized well data systems can (1) assist in oil and gas exploration by permitting comparative analyses between existing fields and new prospects; (2) provide aid to production management and technology by permitting case history studies on the effects of different practices; (3) give smaller companies and independent operators economical access to valuable data; and (4) assist government agencies in designing programs for promotion and regulation of the search for hydrocarbons.

OPDS handles a wide spectrum of data types, e.g., management information, reservoir and production unit data, drilling data, production statistics, logging, chemical analyses, stratigraphy, mineralization, lengthy descriptive narratives, etc. Processes include data entry and verification, report generation, graphs and charts, well location and status mapping, contour mapping, and perspective views of strata or isopachs.

The system consists of a powerful suite of applications programs integrated with a data base management system (DBMS) on DEC VAX computer at a central site. The system can be accessed directly at the central site or, via a telecommunications link, from IBM PCs at remote sites. The PCs are also used independently at remote sites for data entry and verification and other local applications. The main data base of OPDS contains detailed information on 12 000 wells. 3 000 more wells are currently being added and all future wells (approximately 200 per year) will also be added.

Computerized well data systems can influence exploration decisions by allowing rapid and inexpensive evaluation of existing well information to delineate oil and gas prospects. Such systems can also provide aids to production management and technology by permitting exhaustive case history studies of different practices etc. Centralized, publicly accessible, well data systems permit smaller companies and independent operators, unable to support the cost of their own systems, to obtain information rapidly and economically and remain competitive with large companies. Government agencies also use the well and production data to design programs which both encourage and regulate the search for hydrocarbons.

The Ontario Petroleum Data System (OPDS) is an integrated software system for the acquisition, storage, retrieval, and processing of oil and gas well data developed for the Ontario Ministry of Natural Resources, Petroleum Resources Laboratory (PRL) by Dataplotting Services Inc. PRL has usable records for over 15 000 wells in Ontario. The main data base of OPDS contains detailed information on 12 000 of these wells (50 000 000

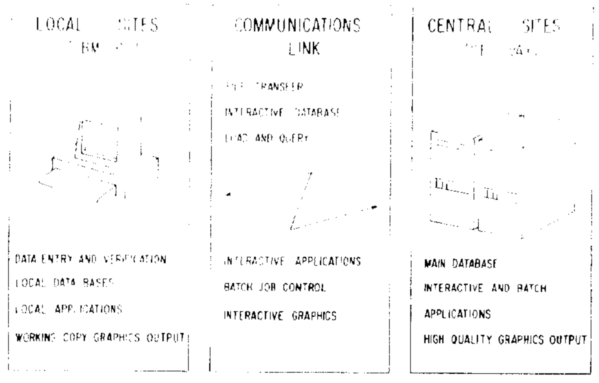

FIG. 1. OPDS configuration.

bytes total). Data on the remainder are being entered; all future wells (200 per year) will also be added to the system.

A wide variety of data types is included—management information, drilling data, production statistics, logging, analyses, geology, etc. Processes include data entry and verification, report generation, statistics, graphs and charts, well location mapping, contour mapping, and perspective views of geologic formations.

The system consists of a powerful suite of applications programs integrated with a data base management system (DBMS) on a DEC VAX computer at a central site. The system can be accessed directly at the central site or from IBM PCs at remote sites. The PCs are also used independently at the remote sites for data entry and verification and other local applications. The main DBMS used is DRS, a product of Advanced Data Management Inc. The PC system uses Ashton Tate's dBASE III. All other software components of the system are members of Dataplotting Services D-PICT series. Figure 1 shows the basic configuration of the OPDS system. The OPDS operations cycle is as follows.

1) The initial data are acquired on standard paper forms (drilling permits, inspectors' reports, geologists' logs, chemical lab reports, etc.) At the local site, these data are entered to PC screen forms. Entries are validated as they are made, e.g., names of geological formations, etc., are checked against permitted values; a depth to a formation top must be greater than the previous depth, and so on. These data are accumulated in local data bases.

2) "Transfer files" are generated by the PC for telecommunications transmission to the main DBMS. These files can be loaded to the main data base immediately after transmission (interactively), or later as a low-cost, off-line batch job.

3) The local site conducts on-line interactive operations with the central site. Queries can be addressed to the main data base and specific information retrieved as tables of figures or reports. Alternatively, the table of figures can be used directly as input to one of the many applications programs available. For example, a table of annual production statistics by geologic formation can be converted to a chart and viewed on the local site graphics monitor. Final copy graphics output can be created on a variety of different graphics devices. Two examples of OPDS graphic output are shown in Figure 2.

4) The local site specifies and directs large scale applications processes to be executed as off-line batch processes. For example, to produce a contour map of the top of a particular geologic formation within a specific geographical region, "command files" specifying the details of the task are set up on the PC then sent to the main system for execution during off-peak hours. The contour map can be previewed on the PC graphics monitor and only sent for final hardcopy plotting when the desired results have been achieved.

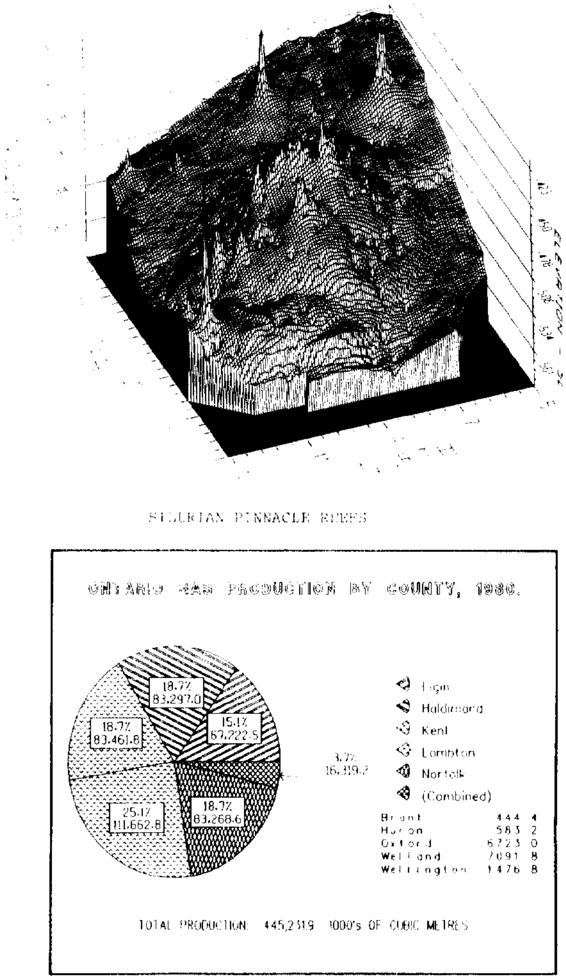

FIG. 2. OPDS graphics.

OPDS operations at the central site include main data base maintenance (backups, error recovery, etc.), large volume data loading and retrieval, large scale applications processes, and high precision, high quality graphics output. Local site operations were recently extended to incorporate a comprehensive exploration lease management and accounting system running on the IBM PCs.

Computer-Assisted Interpretation of Well Logs — BHG 4.8

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WLAI, a set of programs using artificial intelligence techniques, is designed to aid human interpreters in well log interpretation. The task is divided into two subtasks, contact recognition and geologic interpretation. In this paper the characteristics of the problem domain are discussed and the techniques of log curve