

sources, accounting for about 60 per cent of our current research effort, are generally in terms of specific commodities. The lines of attack on these targets include district and regional geologic mapping projects and hydrologic studies, as well as related laboratory investigations.

In research aimed primarily at increasing our scientific knowledge, the geographic targets range from entire states or drainage basins to groups of a few quadrangles; topical targets are the understanding of a variety of fundamental geologic, oceanographic, and hydrologic principles and processes. These basic research projects, which account for about 40 per cent of the Survey's current research effort, include field studies as well as experimental investigations.

Our new long-range program, embarked upon this year, calls for expansion of our mapping and research activities approximately 70 per cent over the next 10 years. Some phases of this long-range program are not measurable in specific units because they are largely concerned with basic research, in which the achievement of one goal may beget several others; in these phases the level of effort is being increased to anticipate and meet the increased requirements that must come with the Nation's continued economic growth. Some finite goals of the more specific phases of the program are: (1) complete once-over topographic map coverage of the entire U. S. with standard 7½- or 15-minute quadrangles by 1976; (2) complete geologic map coverage at 1:250,000 by 1980, and at 1:62,500 by the year 2000; and (3) complete aeromagnetic coverage, at 1-mile spacing, by 1973.

OSTROM, MEREDITH EGGERS, University of Wisconsin, Wisconsin Geological and Natural History Survey, Madison, Wisconsin

PRE-MAQUOKETA (MIDDLE ORDOVICIAN) CYCLIC SEDIMENTS IN THE UPPER MISSISSIPPI VALLEY AREA

Five cycles are recognized in the pre-Maquoketa (Middle Ordovician) marine strata of the Upper Mississippi Valley area: two in Cambrian rocks and three in Ordovician rocks. A sixth unit, at the base of this cyclic section, shows some cyclic characteristics, but is considered to be of non-marine origin.

A complete cycle includes the following units: Phase 4, carbonate deposits; Phase 3, fine-grained sandstone, fossiliferous, dolomitic, and glauconitic and (or) green shale; Phase 2, interbedded coarse-grained sandstone, locally conglomeratic, fossiliferous, dolomitic, and glauconitic, and poorly sorted sandstone composed of particles ranging in grain size from silt to coarse sand; Phase 1, orthoquartzitic sandstone deposits.

Analogous units in each cycle contain similar attributes of mineralogy, grain size, sorting, fossil content, sedimentary structures, contact relations, geometry, and lateral variations. The thickness of cyclic components may vary and components may be locally absent.

Cycles are believed to represent transgressive depositional environments caused by periodic rejuvenation of the land and inner shelf areas with contemporaneous activity in neighboring basins. Materials delivered to the shelf range in grain size from clay to granules. As land areas were worn down, sediments of Phase 1 accumulated on the shelf, building it upward. As the supply of sediment to the shelf decreased, wave and current energy was diverted toward reworking shelf deposits. Deposits of Phase 2 indicate alternating conditions of low and high energy which produced beds of well sorted coarse- and medium-grained sand alternating with poorly sorted beds of materials ranging in size from silt to granules. During Phase 1 and Phase 2 finer par-

ticles were kept in suspension. In Phase 3 these finer particles, together with those removed from shelf deposits during reworking, were deposited. Deposits of Phase 3 are fine-grained sandstone and (or) shale which are commonly dolomitic and glauconitic. Intraformational conglomerates are common. Phase 4 is characterized by carbonate deposition believed to have begun when energy conditions reduced sufficiently for the shelf bottom to stabilize and support life.

PILKEY, ORRIN H., University of Georgia, Marine Institute, Sapelo Island, Georgia.

GOODELL, H. G. Department of Geology, Florida State University, Tallahassee, Florida

TRACE ELEMENTS IN RECENT AND FOSSIL MOLLUSK SHELLS

Analyses were performed for iron, magnesium, manganese, strontium, barium, and mineralogy in the shells of seven species of mollusks collected over much of their present-day environmental range. Correlations between the shell composition and water temperature and salinity were determined in order to evaluate the feasibility of a paleoecological tool using these elements. Significant relationships were observed, but they are generally too weak to be used for paleoecological determinations and are not consistent between species. Differences in salinity cause greater changes in shell composition than differences in temperature, but salinities above 25 ppt. do not greatly affect the shell composition.

Unrecrystallized Miocene and Pleistocene shells of five of the same species were analyzed for comparison with the Recent shells. The average magnesium and manganese contents of the aragonitic fossil shells are lower, whereas the strontium, barium, and iron contents are higher than in Recent shells of the same species. The mean strontium and magnesium contents are lower in the fossil shells of the single calcitic species studied, and the remainder of the elements do not differ significantly. The difference in composition of fossil and Recent shells are attributed to post-depositional effects.

Paleoecological studies based on the composition of carbonate skeletons, radioactive disequilibrium age dating, and the oxygen isotope paleotemperature method should be used with the realization that changes in the trace element content of both aragonite and calcite can occur without recrystallization.

PRICE, W. ARMSTRONG, Corpus Christi, Texas

PATTERNS OF FLOW AND CHANNELING IN TIDAL INLETS

Tidal inlets penetrating narrow barriers and with or without tidal deltas typically have a central trough with terminal channel fans. The trough is centrally narrowly branched at each end with multiple, lesser, converging lateral channels. Deltaic sand, where present, tends to form peripheral shoals and shoals separating the two sets of channels. The trough is a narrow horizontal slot, ratio 1/24 to 1/75 in typical examples. Deep holes occur in axial and other narrows.

Detailed studies by others show that the individual channels of an inlet can usually be identified as either entering or issuing channels, subject to being shifted by longshore currents as the tidal phases change. Without further direct current studies, the gross flow characteristics of the channel systems may be interpreted from the described conditions. In both flood and ebb (rising and falling) phases, the water level is higher on one side of the barrier than the other. For the high sheet of water to get through the inlet, it must drain centripetally into it along all unobstructed radii, a *tidal drain*. The wide