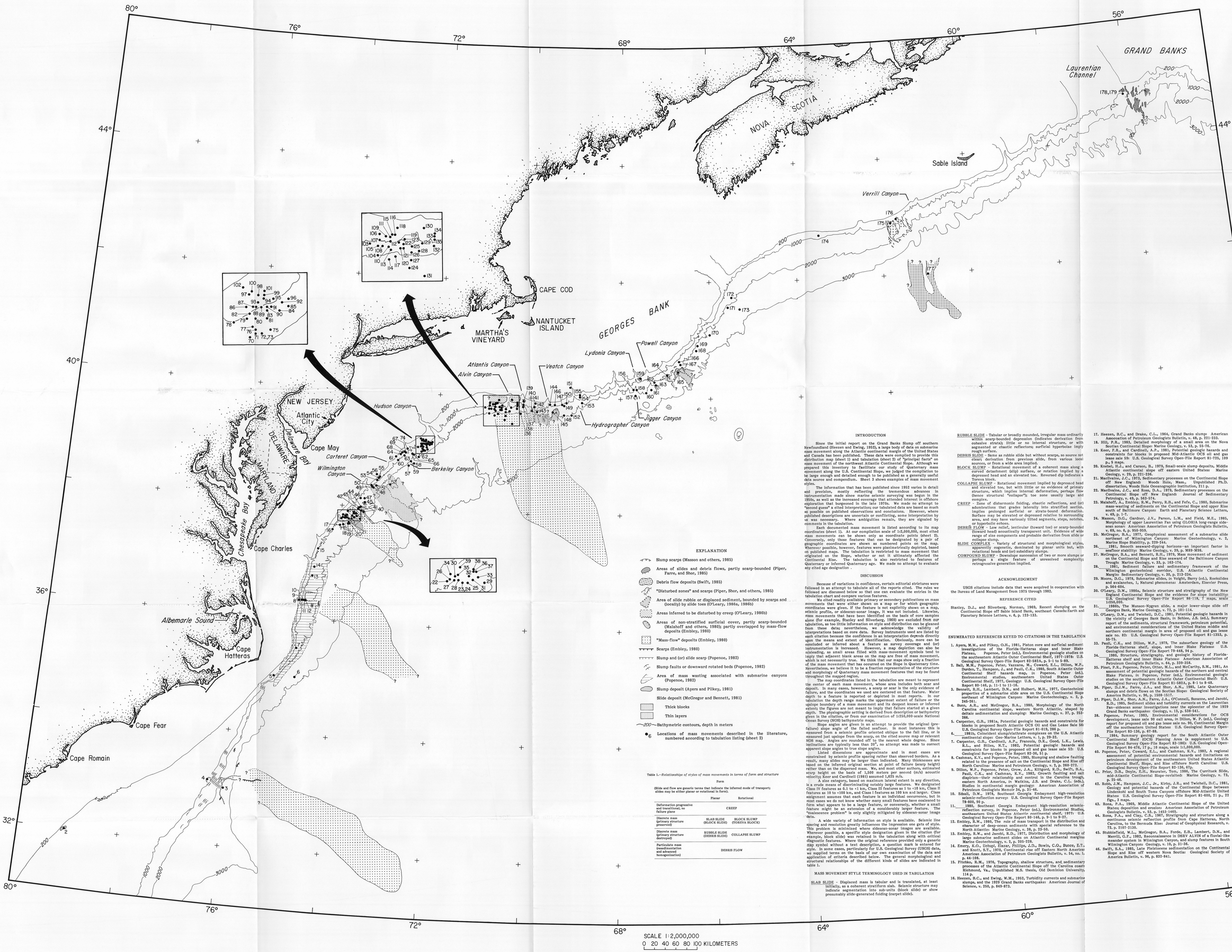
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



EXPLANATION

- Slump scarps (Masson and others, 1985)
- Areas of slides and debris flows, partly scarp-bounded (Piper, Farre, and Shor, 1985)
- Debris flow deposits (Swift, 1985)
- "Disturbed zones" and scarps (Piper, Shor, and others, 1985)
- Area of slide rubble or displaced sediment, bounded by scarps and (locally) by slide toes (O'Leary, 1986a, 1986b)
- Areas inferred to be disturbed by creep (O'Leary, 1986b)
- Areas of non-stratified surficial cover, partly scarp-bounded (Malahoff and others, 1980); partly overlapped by mass-flow deposits (Embley, 1980)
- "Mass-flow" deposits (Embley, 1980)
- Scarps (Embley, 1980)
- Slump and (or) slide scarp (Popenoe, 1982)
- Slump faults or downward rotated beds (Popenoe, 1982)
- Area of mass wasting associated with submarine canyons (Popenoe, 1982)
- Slump deposit (Ayers and Pilkey, 1981)
- Slide deposit (McGregor and Bennett, 1981)
- Thick blocks
- Thin layers
- 200 Bathymetric contours, depth in meters
- •6 Locations of mass movements described in the literature, numbered according to tabulation listing (sheet 2)

Table 1.--*Relationships of styles of mass movements in terms of form and structure*

Form (Slide and flow are generic terms that indicate the inferred mode of transport); slides may be either planar or rotational in form).	Planar	Rotational
Deformation progressive and transitional, no failure plane	CREEP	
Discrete mass (primary structure preserved)	SLAB SLIDE (BLOCK SLIDE)	BLOCK SLUMP (TOREVA BLOCK)
Discrete mass (primary structure destroyed)	RUBBLE SLIDE (DEBRIS SLIDE)	COLLAPSE SLUMP
Particulate mass (resedimentation and advanced homogenization)	DEBRIS FLOW	

INTRODUCTION

Since the initial report on the Grand Banks Slump off southern Newfoundland (Heezen and Ewing, 1952), a large body of data on submarine mass movement along the Atlantic continental margin of the United States and Canada has been published. These data were compiled to provide this distribution map (sheet 1) and tabulation (sheet 2) of "principal facts" on mass movement of the northwest Atlantic Continental Slope. Although we prepared this inventory to facilitate our study of Quaternary mass movement along the U.S. Continental Slope, we judged the compilation to be large enough and detailed enough to be published as a generally useful data source and compendium. Sheet 3 shows examples of mass movement styles.

The information that has been published since 1952 varies in detail and precision, mostly reflecting the tremendous advances in instrumentation and marine seismic surveying was begun in the 1950s, as well as the increased coverage that attended interest in offshore exploration that burgeoned in the late 1970s. We made no attempt to "second guess" a cited interpretation our tabulated data are based as much as possible on published observations and conclusions. However, where published descriptions are uncertain or conflicting, some interpretation is by us was necessary. Where ambiguities remain, they are signaled by comments in the tabulation.

Each documented mass movement is listed according to its map coordinates (sheet 1). At our compilation scale of 1:2,000,000, most cited mass movements can be shown only as coordinate points (sheet 2). Conversely, only those features that can be designated by a pair of geographic coordinates are shown as numbered points on the map. Wherever possible, however, features were plani-metrically depicted, based on published maps. The tabulation is restricted to mass movement that originated on the Slope, whether or not it ultimately affected the Continental Rise. The tabulation is also restricted to features of Quaternary or inferred Quaternary age. We made no attempt to evaluate any cited age designation .

DISCUSSION

Because of variations in confidence, certain editorial strictures were followed in an attempt to tabulate all of the reports cited. The rules we followed are discussed below so that one can evaluate the entries in the tabulation chart and compare various features.

We cited readily available primary or secondary publications on mass movements that were either shown on a map or for which geographic coordinates were given. If the feature is not explicitly shown on a map, seismic profile, or sidescan-sonar image, it was not included. Likewise, mass movements that have been identified on the basis of core samples alone (for example, Stanley and Silverberg, 1969) are excluded from our tabulation, as too little information on style and distribution can be gleaned from these data; nevertheless, we acknowledge the validity of interpretations based on core data. Survey instruments used are listed by each citation because the confidence in an interpretation depends directly upon the means and extent of identification. Obviously, more can be concluded or inferred about a feature as survey coverage and (or) instrumentation is increased. However, a map depiction can also be misleading, as small areas filled with mass-movement symbols tend to imply that adjacent blank areas on the map are free of mass movement, which is not necessarily true. We think that our maps show only a fraction of the mass movement that has occurred on the Slope in Quaternary time. Nevertheless, we believe it to be a fraction representative of the structure and morphology of Quaternary mass movement features that may be found throughout the mapped region.

The map coordinates listed in the tabulation are meant to represent the center of each mass movement, whose area includes both scar and deposit. In many cases, however, a scarp or scar is the only evidence of failure, and the coordinates we used are centered on that feature. Water depth to a feature is reported or depleted in most reports. In our tabulation the depth range marks the uppermost extent of failure or the upslope boundary of a mass movement and its deepest known or inferred extent; the figures are not meant to imply that failure started at a given depth. The physiographic setting is derived from description or bathymetry given in the citation, or from our examination of 1:250,000-scale National Ocean Survey (NOS) bathymetric maps.

Slope angles are given in an attempt to provide the original (pre-failure) slope angle of the failed seafloor. In most instances this is measured from a seismic profile oriented oblique to the fall line, or is measured just upslope from the scarp, on the cited source map or relevant NOS map. Angles are rounded off to the nearest whole degree. Since inclinations are typically less than 20°, no attempt was made to correct apparent slope angles to true slope angles.

Listed dimensions are approximate and in most cases are constrained by seismic profile spacing rather than observed borders. As a result, many slides may be larger than indicated. Many thicknesses are based on the inferred original section at point of failure (scarp height) rather than on the dispersed mass. We, and most other authors, estimated scarp height on the basis of 1,500 meters per second (m/s) acoustic velocity for sediment. Cardioff (1981) assumed 1,625 m/s.

A size category, based on maximum lateral extent in any direction, is a crude means of discriminating notably large features. We designated Class IV features as 0.1 to <1 km, Class III features as 1 to <10 km, Class II features as 10 to <100 km, and Class I features as 100 km and larger. Class assignment assumes that each feature is an individual occurrence, but in most cases we do not know whether many small features have coalesced to form what appears to be a large feature, or conversely, whether a small feature might be an extension of a considerably larger feature. The "coalescence problem" is only slightly mitigated by sidescan-sonar image data.

A wide variety of information on style is available. Seismic line spacing and resolution greatly influences the impression one gets of style. This problem is minimized where sidescan-sonar images are available. Wherever possible, a specific style designation given in the citation (for example, block slide) was retained in the tabulation along with critical diagnostic features. Where the original reference provided only a generic map symbol without a text description, a question mark is entered for style. In some cases, particularly for U.S. Geological Survey (USGS) data, we supplied terms on the basis of our own examination of the data and application of criteria described below. The general morphological and structural relationships of the different kinds of slides are indicated in table 1.

MASS MOVEMENT STYLE TERMINOLOGY USED IN TABULATION

SLAB SLIDE - Displaced mass is tabular and is translated, at least initially, as a coherent stratiform slab. Seismic structure may indicate segmentation into sub-units (block slide) or show presumably slide-generated folding (carpet slide).

RUBBLE SLIDE - Tabular or broadly mounded, irregular mass ordinarily within scarp-bounded depression (indicates derivation from cohesive strata); little or no internal structure, or with segmented or chaotic reflectors; surficial hyperbolae imply rough surface.

DEBRIS SLIDE - Same as rubble slide but without scarps, so source not clear; derivation from previous slide, from various local sources, or from a wide area implied.

BLOCK SLUMP - Rotational movement of a coherent mass along a curved detachment (slip) surface, or rotation implied by a depressed head and an elevated toe. Reversed dip indicates a toreva block.

COLLAPSE SLUMP - Rotational movement implied by depressed head and elevated toe, but with little or no evidence of primary structure, which implies internal deformation, perhaps flow (sometimes structural "collapse"); toe zone usually large and complex.

CREEP - Zone of disharmonic folding, chaotic reflections, and (or) submerbations that grades laterally into stratified section, implies prolonged surficial or strata-bound deformation. Surface may be elevated or depressed relative to surrounding area, and may have variously tilted segments, steps, notches, or hyperbolic echoes.

DEBRIS FLOW - Low relief, lenticular (toward toe) or scarp-bounded (toward head) acoustically transparent unit. Evidence of wide range of size components and probable derivation from slide or collapse slump.

SLIDE COMPLEX - Variety of structural and morphological styles, apparently cogenetic, dominated by planar units but, with rotational heads and (or) subsidiary slumps.

COMPOUND SLUMP - Downslope succession of two or more slumps or perhaps a single feature of unresolved complexity; retrogressive generation implied.

ACKNOWLEDGMENT

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MAP AND TABULATION OF QUATERNARY MASS MOVEMENTS ALONG THE UNITED STATES–CANADIAN ATLANTIC CONTINENTAL SLOPE FROM 32°00′ TO 47°00′N. LATITUDE

By
J.S. Booth, D.W. O'Leary, Peter Popenoe, J.M. Robb and B.A. McGregor

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