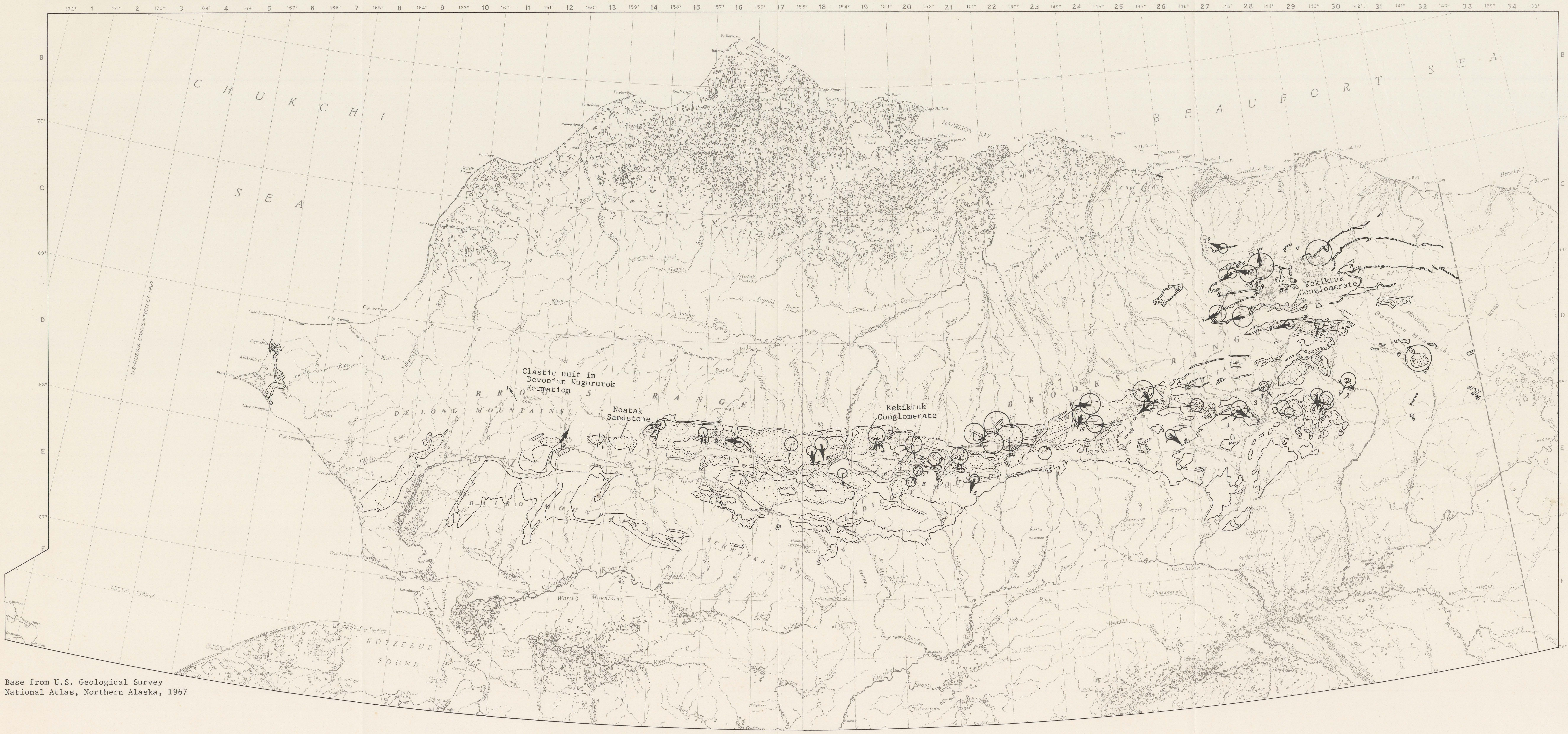
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-692



Base from U.S. Geological Survey
National Atlas, Northern Alaska, 1967

SCALE 1:7 500 000

100 0 100 200 300 400 500 MILES

100 0 100 200 300 400 500 KILOMETRES

EXPLANATION

Mean size of 10 largest clasts of vein quartz at each station:

- >100 mm
- 75-100 mm
- 50-75 mm
- 25-50 mm
- <25 mm

6 — Vector mean of current directions and number of readings (5 or more)

1 — Current directions and number of readings (less than 5)

Current direction indicator with indeterminate sense

Generalized distribution of Endicott Group and correlative rocks--Modified from Lathram (1965; also unpub. revisions), Reiser and others (1971), Pessel and others (1973), Reiser and others (1974), and unpublished maps of the Baird Mountains by G. H. Pessel and R. E. Garland, and by W. P. Brosgé and I. L. Tailleur

INTRODUCTION

The Devonian-Mississippian Endicott Group (Tailleur and others, 1967) is an important geologic unit in the Brooks Range of northern Alaska. It reflects a major tectonic event in the middle and late Paleozoic history of the North American Cordillera. Tailleur and Brosge (1970) interpreted the Endicott as a clastic wedge derived from land to the north during the Late Devonian and from land to the northeast during Early Mississippian, when a shallow sea transgressed the area. In the north-central and eastern parts of the range, the Endicott is composed of three formations, in ascending order, the Upper Devonian Hunt Fork Shale and Kanayut Conglomerate and the Lower Mississippian Kayak Shale; in the western part of the range, the stratigraphic relations of these formations with formations in the Endicott is uncertain. Donovan systematically collected paleocurrent and clast-size data from the Endicott Group along the Brooks Range for Mobil Oil Corporation in 1967 and 1968. In recognition of the general interest in the information, Mobil has permitted its release. I. L. Tailleur summarized the regional geologic information.

The thickest parts of the clastic wedge, more than 2 km thick, have been compressed into east-west-striking folds and faults that form a belt across the north-central part of the range (Porter, 1966). In the central and eastern parts of the range, the lower part of the wedge consists of marine shale and sandstone of the Hunt Fork Shale, which grades upward and intertongues southward with quartzite and conglomerate of the Kanayut Conglomerate. The top of the wedge is the marine Kayak Shale, which also contains subordinate amounts of sandstone and limestone. The clastic wedge may have no roots in subjacent sequences (Tailleur and others, 1967, p. 1359; Brosgé and others, 1974), and the whole wedge may have been underthrust southward by the southern margin of the old source area during late Mesozoic orogeny (Tailleur and Snelson, 1968).

Westward, the Endicott Group consists of the Hunt Fork Shale, which is possibly a slightly more distal continuation of the Kanayut Conglomerate, and sandstone and shale of the Upper Devonian and Lower Mississippian Noatak Sandstone (Dutro, 1953). In the Sivukat Mountain area west of the lower Noatak River, the Endicott includes quartzite and conglomerate (Martin, 1970), allochthonous upon a Mesozoic terrane and structurally unconnected to eastern clastic units. On the west coast of Alaska and the west limb of the Chukchi syntaxis (Tailleur and Brosgé, 1970), paralic deposits intertongue with Upper Mississippian carbonate (Armstrong and others, 1970) in the lower part of the Lisburne Group. These paralic deposits are about 1 km thick and contain plant remains of Early Mississippian age and minable amounts of low-volatile bituminous coal (Tailleur, 1965). Tailleur found that these deposits overlie, with uncertain relations, clastic rocks of uncertain age (U.S. Geological Survey, 1972).

The north-transgressive phase of the clastic wedge in the northeastern mountains and in the subsurface to the northwest is considerably thinner. A variable, conglomeratic and paralic unit, Kekiktuk Conglomerate (Brosgé and others, 1962), lies on deformed and peneplaned(?) Devonian and older rocks (Reiser and others, 1971, 1974). The overlying Kayak Shale grades upward into the carbonate beds of the Lisburne Group and is of Early(?) and Late Mississippian age in the north (Armstrong, 1971). The transgressive phase has probably been structurally juxtaposed with thicker deposits to the south.

The clastic wedge is similar to other, better understood Devonian-Mississippian rocks on the North American craton and around the periphery of the North Atlantic. It may, therefore, have been part of the same tectonic and depositional cycle in both North America and Europe. Probably, it was once connected with the Upper Devonian Nation River Formation (Brabb and Churkin, 1969) of east-central Alaska, along the Yukon River. This Upper Devonian turbidite was deposited in a deep marine basin (Nilsen and others, 1974). Summarized descriptions of basal and pre-Mississippian rocks in northern Alaska were presented by Brosgé and Tailleur (1971).

METHOD OF INVESTIGATION

Directional features that were measured include, in decreasing order of abundance, crossbedding, current lineation, groove and flute(?) casts, ripple markings, cut-and-fill structures, and oriented fossil plant stems. Uncommon transverse-crack casts (Daley, 1968) were also measured.

Crossbedding and current lineations are the most useful directional features in the Kanayut and Kekiktuk Conglomerates. Tabular, festoon, and intermediate types of crossbeds exist. They range in amplitude from a few centimetres to a metre (largest observed). The orientations of linear features were measured directly by Brunton compass. Crossbedding was measured by taking the strike and dip of the plane of foreset beds exposed by two intersecting outcrop faces. The conditions of exposure at most localities dictated the number and quality of measurements that effectively could be made. Severely frost-heaved units, extensive lichen growth, and lack of intersecting outcrop faces in well-indurated units often precluded measurement of directional features.

All measurements were corrected for structural tilt when necessary. It was possible to correct for tilt in the field in a few instances, but most corrections were made in the office using a stereonet (Potter and Pettijohn, 1963, p. 259-262). Directional features having an indeterminate current sense were assigned the sense determined for adjacent crossbedding or for another appropriate indicator. The vector means of the paleocurrent directions for each station with five or more individual measurements were calculated by computer and plotted. All readings were plotted for stations with less than five measurements. One-hundred and seventy-seven measurements were taken at 38 localities.

The mean maximum clast size at each station was determined by measuring the maximum diameters of the 10 largest white vein-quartz clasts (determined by inspection) and computing their average (Pelletier, 1958). All clasts appear well rounded. Only white vein-quartz clasts were measured, in order to avoid lithologically controlled variations in resistance to abrasion, and because they are ubiquitous in both the Kanayut and Kekiktuk Conglomerates.

CONCLUSIONS

Inspection of the paleocurrent data indicates that the Kanayut originated from a northern source and the Kekiktuk from an eastern source. The large area covered and the limited data do not permit a refined interpretation. However, directional features are remarkably consistent over wide areas, and the decrease in maximum clast size from east to west and from north to south is pronounced. The abrupt decrease in clast size over relatively short distances is probably exaggerated because of appreciable crustal shortening by folding and over-thrusting. The dispersal patterns suggest that the Kanayut was derived from a westerly- or northwesterly-trending source area and that the Kekiktuk was derived from a more areally restricted source area, somewhere near the present United States-Canada border. This is in agreement with the field and petrographic evidence of Reed (1968, p. 33), who made a similar conclusion regarding the source of Kekiktuk sediments.

These paleocurrent and clast-size determinations serve two useful purposes: they provide some quantitative information for the Endicott Group, and they demonstrate the need for more data. Additional measurements at numerous localities should refine the source indication and yield criteria for distinguishing structural dislocations.

REFERENCES

Armstrong, A. K., 1971, Mississippian Lisburne Group, Cape Lewis-Niak Creek, northwestern Alaska: U.S. Geol. Survey Prof. Paper 750-B, p. B23-B34.

Armstrong, A. K., Mamet, B. L., and Dutro, J. T., Jr., 1970, Foraminiferal zonation and carbonate facies of Carboniferous (Mississippian and Pennsylvanian) Lisburne Group, central and eastern Brooks Range, Arctic Alaska: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 5, p. 687-698.

Brabb, E. E., and Churkin, Michael, Jr., 1969, Age of Nation River Formation, east-central Alaska (discussion of paper by L. R. Laudon and others, 1966): Am. Assoc. Petroleum Geologists Bull., v. 53, no. 2, p. 430-439.

Brosgé, W. P., Dutro, J. T., Jr., Mangus, M. D., and Reiser, H. N., 1962, Paleozoic sequence in eastern Brooks Range, Alaska: Am. Assoc. Petroleum Geologists Bull., v. 46, no. 12, p. 2174-2198.

Brosgé, W. P., Reiser, H. N., and Tailleur, I. L., 1974, Pennsylvania beds in Lisburne Group, south-central Brooks Range, in Carter, Claire, ed., United States Geological Survey Alaska program, 1974: U.S. Geol. Survey Circ. 700, p. 41.

Brosgé, W. P., and Tailleur, I. L., 1971, Northern Alaska petroleum province, in Cram, I. H., ed., Future petroleum provinces of the United States--Their geology and potential. Am. Assoc. Petroleum Geologists Mem. 15, v. 1, p. 68-99.

Daley, Brian, 1968, Sedimentary structures from a non-marine horizon in the Bembridge marls (Oligocene) of the Isle of Wight, Hampshire, England: Jour. Sed. Petrology, v. 38, no. 1, p. 114-127.

Dutro, J. T., Jr., 1953, Stratigraphy and paleontology of the Noatak and associated formations, Brooks Range, Alaska [abs.]: Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1415.

Lathram, E. H., 1965, Preliminary geologic map of northern Alaska: U.S. Geol. Survey Open-file Map, scale 1:1,000,000.

Martin, A. J., 1970, Structure and tectonic history of the western Brooks Range, De Long Mountains and Lisburne Hills, northern Alaska: Geol. Soc. America Bull., v. 81, no. 12, p. 3605-3621.

Nilsen, T. H., Brabb, E. E., and Simoni, T. R., Jr., 1974, The Nation River Formation--A Devonian turbidite in east-central Alaska: Geol. Soc. America Abs. with Programs, v. 6, no. 7, p. 1051-1052.

Pelletier, B. R., 1958, Pocono paleocurrents in Pennsylvania and Maryland: Geol. Soc. America Bull., v. 69, no. 8, p. 1033-1064.

Pessel, G. H., Garland, R. E., Tailleur, I. L., and Eakins, G. R., 1973, Preliminary geologic map of southeastern Ambler River and part of Survey Pass quadrangles, Alaska: Alaska Div. Geol. and Geophys. Surveys Open-file Report 28.

Porter, S. C., 1966, Stratigraphy and deformation of Paleozoic section at Anaktuvuk Pass, central Brooks Range, Alaska: Am. Assoc. Petroleum Geologists Bull., v. 50, no. 5, p. 952-980.

Potter, P. E., and Pettijohn, F. J., 1963, Paleocurrents and basin analysis: New York, Academic Press, 296 p.

Reed, B. L., 1968, Geology of the Lake Peters area, northeastern Brooks Range, Alaska: U.S. Geol. Survey Bull. 1236, 132 p.

Reiser, H. N., Brosge, W. P., Dutro, J. T., Jr., and Detterman, R. L., 1971, Preliminary geologic map, Mount Michelson quadrangle, Alaska: U.S. Geol. Survey Open-file Map, scale 1:200,000.

_____1974, Preliminary geologic map of the Demarcation Point quadrangle, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-610, scale 1:200,000.

Tailleur, I. L., 1965, Low-volatile bituminous coal of Mississippian age on the Lisburne Peninsula, north-western Alaska, in Geological Survey research 1965: U.S. Geol. Survey Prof. Paper 525-B, p. B34-B38.

Tailleur, I. L., and Brosgé, W. P., 1970, Tectonic history of northern Alaska, in Adkinson, W. L., and Brosgé, M. M., eds., Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Am. Assoc. Petroleum Geologists Pacific Sec. p. E1-E19.

Tailleur, I. L., Brosgé, W. P., and Reiser, H. N., 1967, Palinspastic analysis of Devonian rocks in northwestern Alaska, in Oswald, D. H., ed., International symposium on the Devonian System, Calgary, Alberta, 1967 [Proc.], v. 2: Calgary, Alberta Soc. Petroleum Geologists, p. 1345-1361 [1968].

Tailleur, I. L., and Snelson, Sigmund, 1968, Large-scale flat thrusts in the Brooks Range orogen, northern Alaska [abs.]: Geol. Soc. America Spec. Paper 101, p. 217.

U.S. Geological Survey, 1972, Lisburne Peninsula, in Geological Survey research 1972: U.S. Geol. Survey Prof. Paper 800-A, p. A50.

MAP SHOWING PALEOCURRENT AND CLAST-SIZE DATA FROM THE DEVONIAN-MISSISSIPPIAN ENDICOTT GROUP, NORTHERN ALASKA

By
T. J. Donovan and I. L. Tailleur

1975

Alaska (1:7,500,000. 1975

For sale by U. S. Geological Survey, price 50 cents
☆U.S. GOVERNMENT PRINTING OFFICE: 1975—677-340/14