Assignment 3. ANALYSIS OF PALEOCURRENT DATA

Introduction

The flow direction of currents that laid down clastic sedimentary deposits can be determined from a variety of fabrics and primary structures that have, or will be, considered in ERSC/GEOG 2P16. In almost all cases where such directional data are used it is necessary to collect a large number of measurements to derive at least a reliable (if not statistically significant) picture of paleocurrents in ancient depositional environments. Paleocurrents, in turn, may lead to an improved understanding of sediment transport directions, basin geometry, source area location, etc., and, therefore, may make a very important contribution to any sedimentological study. In this exercise you will apply the techniques for dealing with directional data that are outlined in Chapter 2 of the course notes. The exercise will provide an opportunity to calculate the various statistics for paleocurrent data and to construct rose diagrams. In addition, part B illustrates how actual paleocurrent data may be used to infer something of the geological history of an area.

Part A. Analysis of directional data

Table I contains three sets of hypothetical paleocurrent data. Group the data into classes at 30° intervals and construct a rose diagram for each set of data on the appropriate circular graph. Compute all of the relevant values to describe the data set (the direction (θ) and magnitude (R) of the resultant vector, the magnitude of the resultant vector expressed as a percentage of the total number of observations (L), and the probability that the data are uniformly distributed (p). Record your results in table form.

Discuss the significance of θ, R, L and p for each data set and discuss the differences between the three samples.

Part B. Paleocurrent analysis

1. Table II (parts a to d) contains paleocurrent data based on a number of sedimentary structures and primary fabric from the Peel Sound Formation at Pressure Point, Somerset Island, Northwest Territories. The sedimentary facies (lithologies from specific depositional environments) of the Peel Sound Formation include:

a) Conglomerate with imbricate clasts and interbeds of sandstones displaying small-scale planar cross-bedding. Note that imbricate clasts in the conglomerate dip upstream whereas the small-scale cross-beds dip in the downstream direction. This facies is interpreted to be the deposits of alluvial fans.

b) Pebbly sandstone with trough cross-beds. In this case the dip direction of the cross-bedding is also in the flow direction. The facies is the deposit of a braided fluvial system.

c) Well-sorted sandstones with large-scale planar-tabular cross-bedding (cross-bed sets are up to 6 m thick). These are the deposits of an eolian (desert) environment and the cross-beds dip in the direction of the predominant wind.

Plot the paleocurrent data in Table II at 10° class intervals on the appropriate circular graphs. Calculate all of the relevant statistics to describe each distribution and show the direction of the resultant vector on each rose diagram. Record the results of your calculations in table form.

Note that the locations where the data were collected are shown on the accompanying map. Answer each of the following questions by comparing your results to the map.

i) What may have been the source of the gravel that was deposited on the alluvial fan and braided stream deposits of the Peel Sound Formation?

ii) Where are the source rocks of the eolian deposits?

iii) Which of the paleocurrent indicators will be most reliable in determining the physiography of the region in which these terrestrial sediments were deposited?

2. The Leopold Formation at Two Rivers Bay, Somerset Island, consists of intertidal sandstones and dolomitic siltstones. In its depositional environment the sediments were deposited in response to reversing tidal currents. Plot the paleocurrent data (Table III) at 30° intervals.

Explain the form of the rose diagram. What can you deduce about the sediment source?

Table I. Hypothetical paleocurrent data.

Set A.	001	016	011	340	032	022	052	028							
Set B.	260	029	062	347	281	110	033	322	079	003	310	272	021	098	
	127	017	045	290	318	058	359	010	333	340					
Set C.	075	229	299	022	152	185	238	358	010	160	222	016	260	047	
	332	315	148	015	280	171	123	111	092	102	035	245	272		

Table II. Paleocurrent data, Peel Sound Formation, Somerset Island

(a) Imbrication in conglomerate.

180	147	256	209	220	255	201	210	200	287	214	193	290	259	196
200														

Small-scale planar cross-bedding in sandstone.

015	061	115	116	165	168	285	023	027	085	124	204	295	041	045
048	095	147	253	256	311	319	055	102	107	154	158	275	355	

(b) Trough cross-bedding

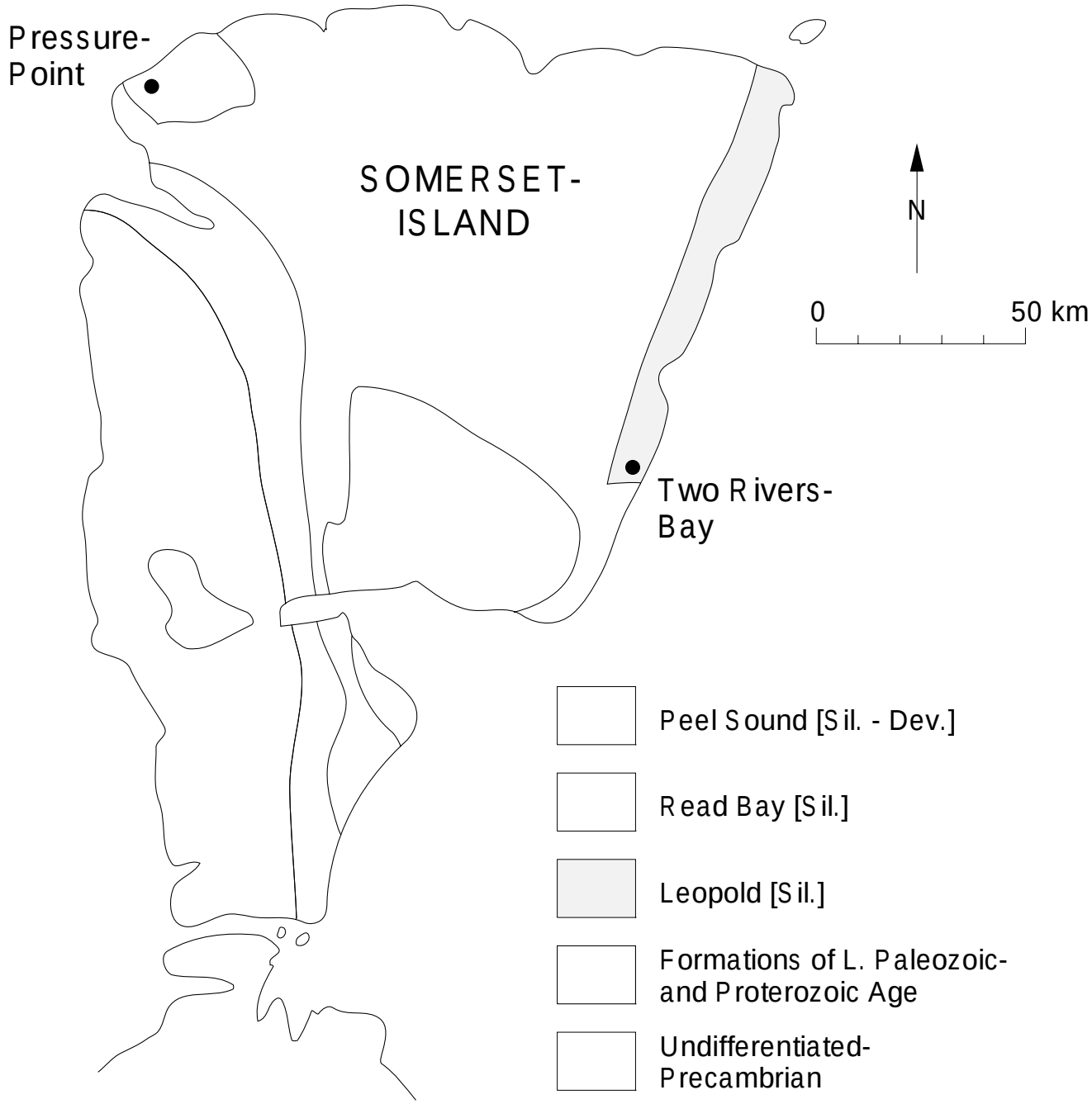
055	071	074	077	125	164	169	025	084	089	132	137	305	035	103
105	106	144	144	148	341	345	345	055	111	111	116	117	119	155 157
354	357													

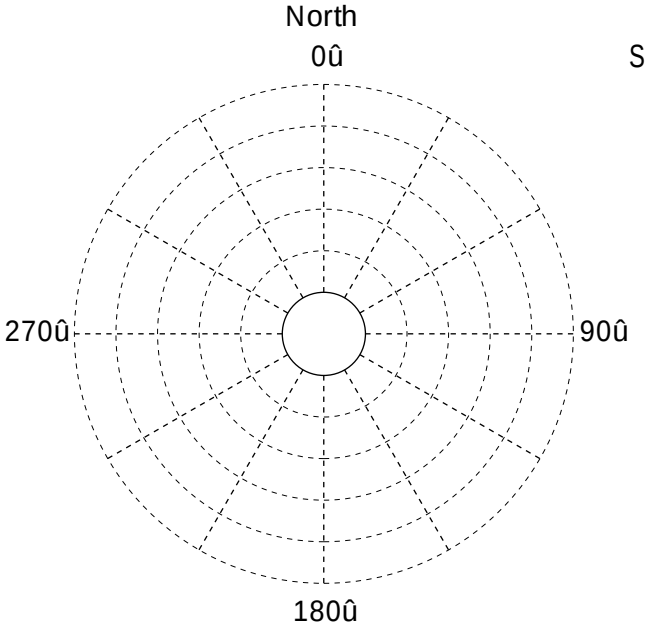
(c) Large-scale planar cross-bedding.

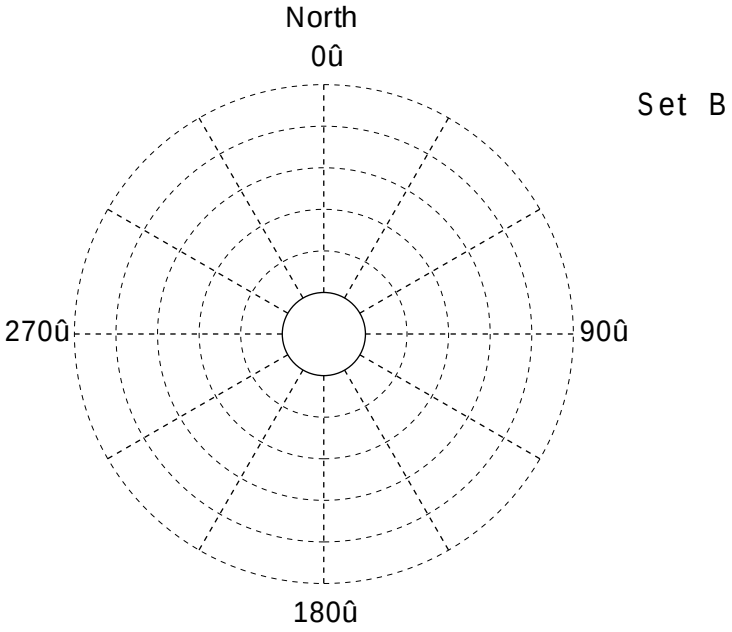
001	003	005	007	145	315	355	011	014	225	325	322

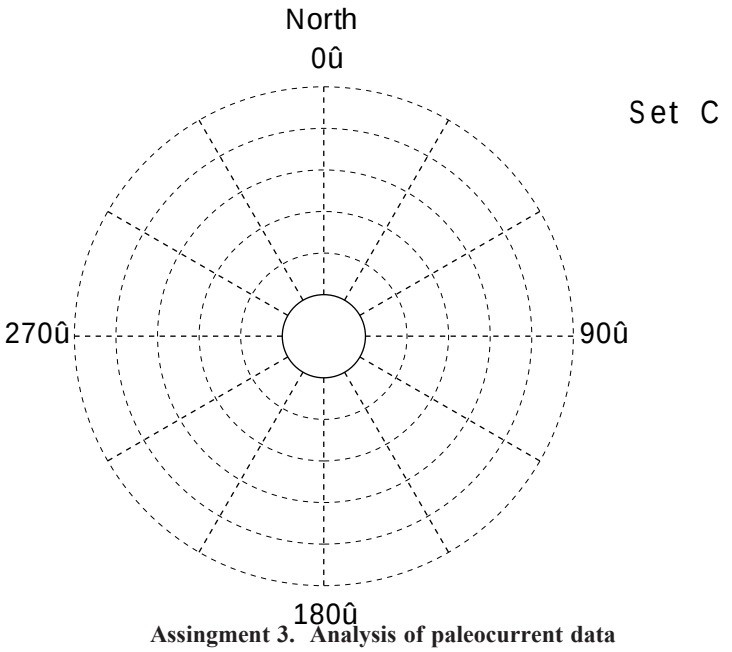
Table III. Paleocurrent data, Leopold Formation, Somerset Island.

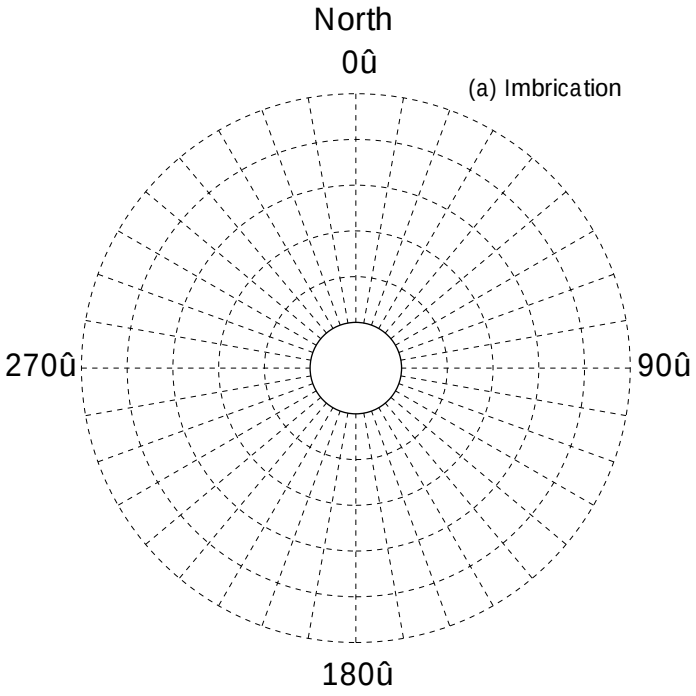
010	130	230	320	020	190	250	070	220	260

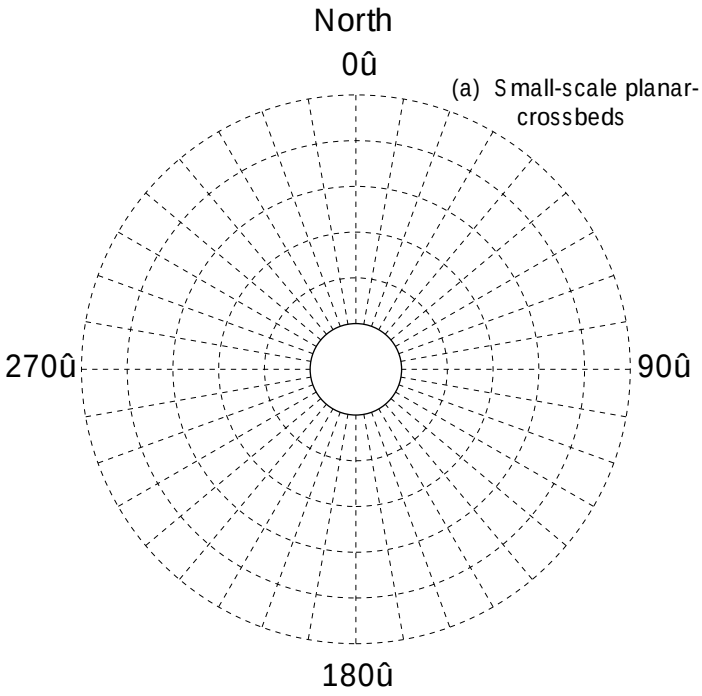

Pressure-
Point
SOMERSET-
ISLAND
N
0
50 km
Two Rivers-
Bay
Peel Sound [Sil. - Dev.]
Read Bay [Sil.]
Leopold [Sil.]
Formations of L. Paleozoic-
and Proterozoic Age
Undifferentiated-
Precambrian

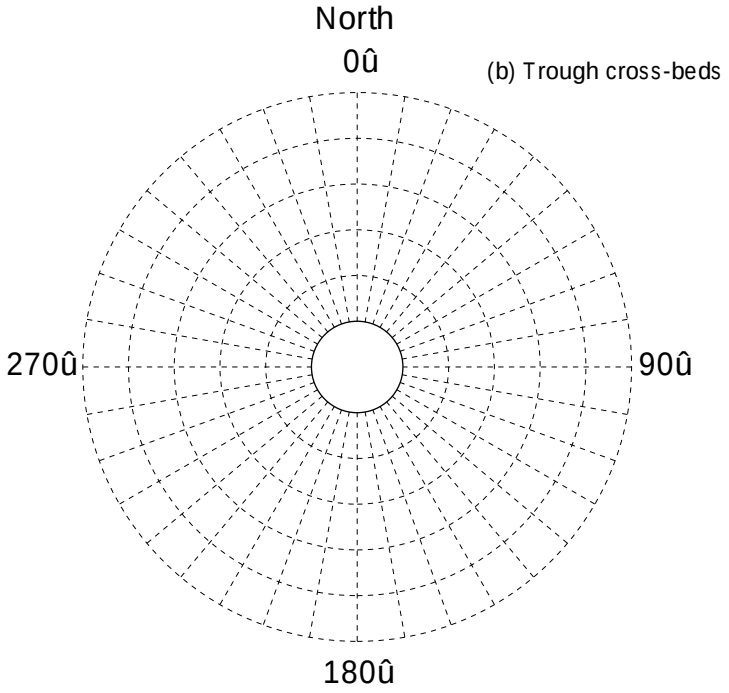

North
0û
Set A
270û
90û
180û

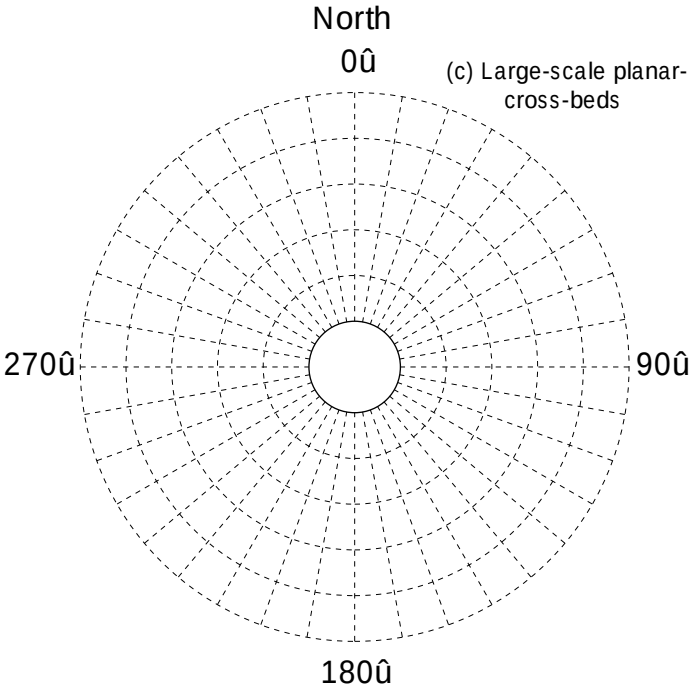

North
0û
Set B
270û
90û
180û

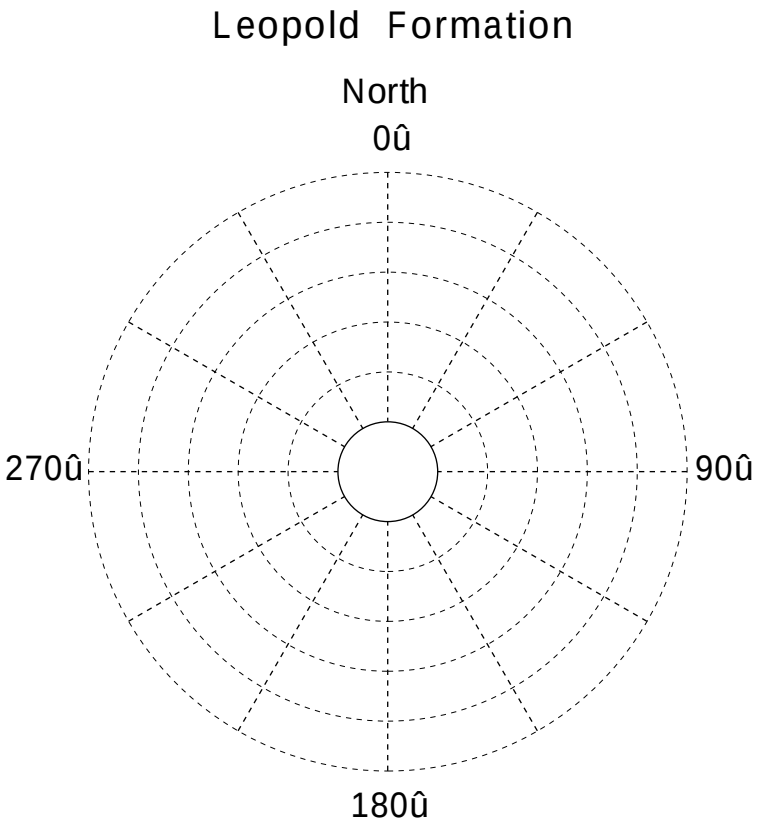

North
0û
Set C
270û
90û
180û


North
0û
(a) Imbrication
270û
90û
180û


North
0û
(a) Small-scale planar-crossbeds
270û
90û
180û


North
0û
(b) Trough cross-beds
270û
90û
180û


North
0û
(c) Large-scale planar-cross-beds
270û
90û
180û



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