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ORIENTATION OF HOLLOWS IN CAVERNOUSLY WEATHERED BOULDERS IN ANTARCTICA ***

Sommaire

Dans la basse vallée de Victoria, au Sud de la Terre de Victoria (Antarctique), 100 trous de blocs erratiques de granite et de gneiss taffonisés ne montrent pas d'orientation préférentielle, alors que le vent en présente deux très nettes (NE et SW); le vent n'a donc probablement pas été le facteur principal de leur formation.

Large, cavernously weathered, erratic boulders of coarse-grained granite and granitic gneiss occur in great numbers in the lower part of Victoria Valley, South Victoria Land, Antarctica (Calkin & Cailleux 1962). In the course of a weathering study of these boulders, the authors noted the apparent uniform (as opposed to preferred) distribution and orientation of the weathering hollows in the boulders. If this uniform distribution and orientation is real, the plentiful hollows in the boulders cannot easily be correlated with the high winds characteristic of the valley today, which clearly show a nearly bilateral, preferred orientation. At least in summer the wind today is predominatly funneled from the northeast up the steep-walled, northeast-southwest oriented valley. But the ventifacts on the valley floor show, on the contrary, a prevailing wind from the west or south-west (winter wind, or former wind.).

In order to lend statistical support to the hypothesis of uniform orientation, the directions (azimuth along the axis of the hollow) in which the hollows face, and the depths of the hollows were measured (table I). A group of highly-weathered boulders, showing a similar degree of weathering, and located near the center of the Valley, about 1 km E of Lake Vida, were chosen for these measurements. It was assumed that the hollows were formed in the erratic boulders after deposition by glaciers. Only the larger boulders (higher than 70 cm) were considered because of their

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Table I

Sample of data as taken in the field

Boulder			Orientation of hollows						Depth of hollows					
	L	H	1	2	3	4	5	6	1	2	3	4	5	6
P	310	100	183	153	23	203			12	20	35	35		
P	295	100	28	83	343	343			12	10	12	10		
P	280	200	193	353	123	113			13	10	14	22		
G	270	120	303	338	188	178	48		20	11	11	20	10	
P	265	117	13	118	208	218	298		52	45	30	40	10	
P	240	130	283	283	53	118	158	188	23	12	15	33	11	10
G	240	125	23	28	228	28	143	(1)	25	60	60	10	20	(2)
P	220	100	113						13					
P	215	90	23						11					
G	205	125	238						10					
P	205	118	168	183	143	43	13	298	20	23	10	12	18	10
P	205	135	313	333	183	218	288		42	11	18	25	25	
G	200	115	8	8	298	178			19	21	12	32		
P	195	145	33	68	68	208	318		22	20	38	10	10	
P	185	115	313	18	108	128	243		18	22	22	28	18	
P	170	140	133						25					
G	165	125	358	98	138				11	12	28			
P	160	100	68	238	213				25	15	10			
P	150	100	203	358					13	15				
P	145	110	213	353	168				14	17	55			
P	140	98	193	278					20	10				
G	135	115	353	273	248	73			12	10	11	15		
P	125	95	138						15					
P	125	105	343	353	98				12	13	25			
P	125	90	28	133	198				10	12	13			
P	120	92	88	333					25	11				
G	120	120	223	323	298	18			20	11	10	16		
P	115	95	163						33					
P	100	95	188	258	8	98			10	25	32	10		

L — length, H — height, P — pink granite, G — gneiss, (1) and 143, 193, 198; (2) and 10, 15, 13.

greater development of hollows, and the unlikelihood of their having been moved during weathering. The depths and azimuths of 100 hollows deeper than 9 cm were measured and then plotted on polar coordinate paper (fig. 1). In several cases the directions in which the hollows faced corresponded and therefore for clarity, the lines representing the depths and azimuths of these hollows were plotted within 3 degrees to either side of the actual measured azimuth line. The plotted results of the measurements (fig. 1) show well the uniform orientation of the hollows. Thus, the present day wind seems not to be the most significant factor in the formation of

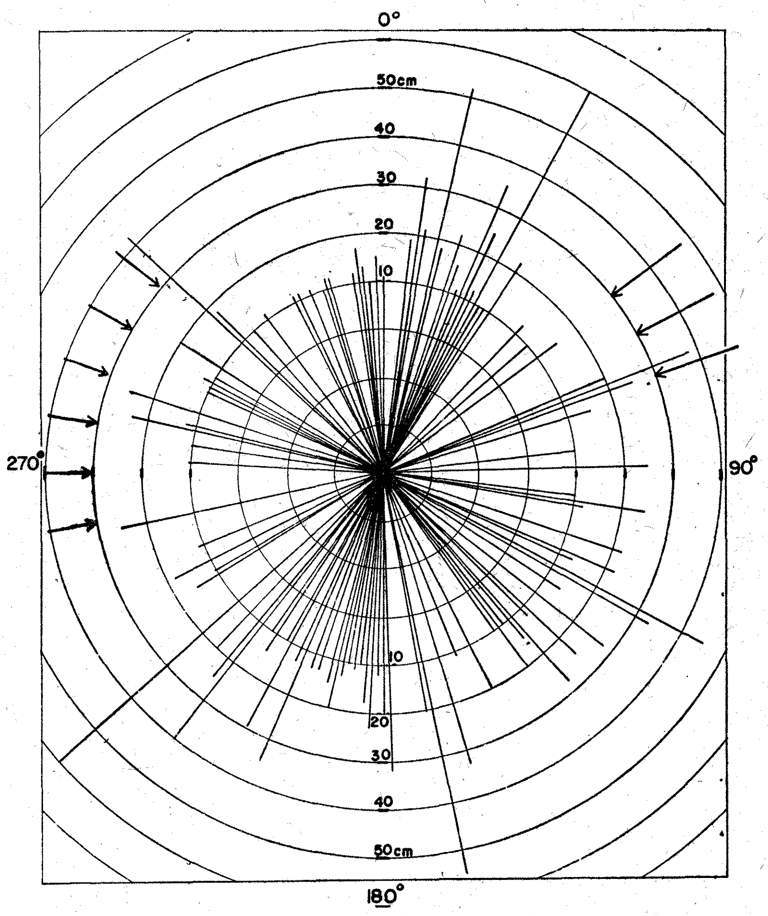

Fig. 1

the hollows and other processes, such as frost action, insolation, dehydration or chemical action, must be considered.

The popular chi-square distribution test, used for comparing observed and model distributions, was applied to the orientation data above (Pincus 1953, p. 492—493). The frequencies of the directions of hollows in 40 degree segments were applied to the standard formula[1] giving a figure for chi-square of 9,12. This in effect expresses a calculated probability that the „observed" distribution curve (in this case an idealized uniform

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[1] Chi-square $(x^2) = {}^1/e \sum_{1}^{k} (o_i - e)^2$; where: o_i — observed frequencies, e — model frequency, k — number of pairs of frequencies.

distribution curve) is the same as the model curve. The chi-square table (Hoel 1958, p. 318), using 8 degrees of freedom (9 segments less 1) and a probability level of 0,05, gives a maximum allowable figure for chi--square of 15,5. This means that the quantity calculated for chi-square (9,12), representing the descrepancy between „observed" and model curves, cannot exceed 15,5 if the probability of the curves being the same is to remain within 95 percent (Hoel 1958, p. 164—172). It is clear from these results that the hypothesis of uniform orientation cannot be rejected.

Photo by A. Cailleux

Pl. 1. Cavernously weathered morainic boulder, pink granite. Southern slope of lower Victoria Valley, Antarctica

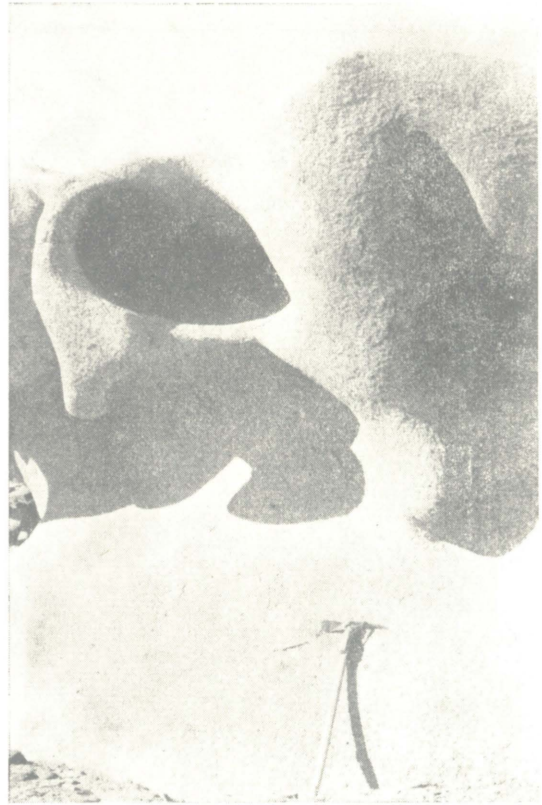

Photo by A. Cailleux

Pl. 2. Detail of plate 1

Photo by P. Calkin

Pl. 3. Dolerite in situ, cavernously weathered. McKelvey Valley, SSW of western end of Lake Vida

Photo by A. Cailleux

Pl. 4. Dolerite in situ, cavernously weathered. McKelvey Valley, SSW of western end of Lake Vida