TILL MACROFABRIC AND GRAIN SIZE ANALYSIS OF GLACIAL DIAMICTONS IN THE SERRA DA CABREIRA MOUNTAINS, NW PORTUGAL

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Introduction and Study Purpose

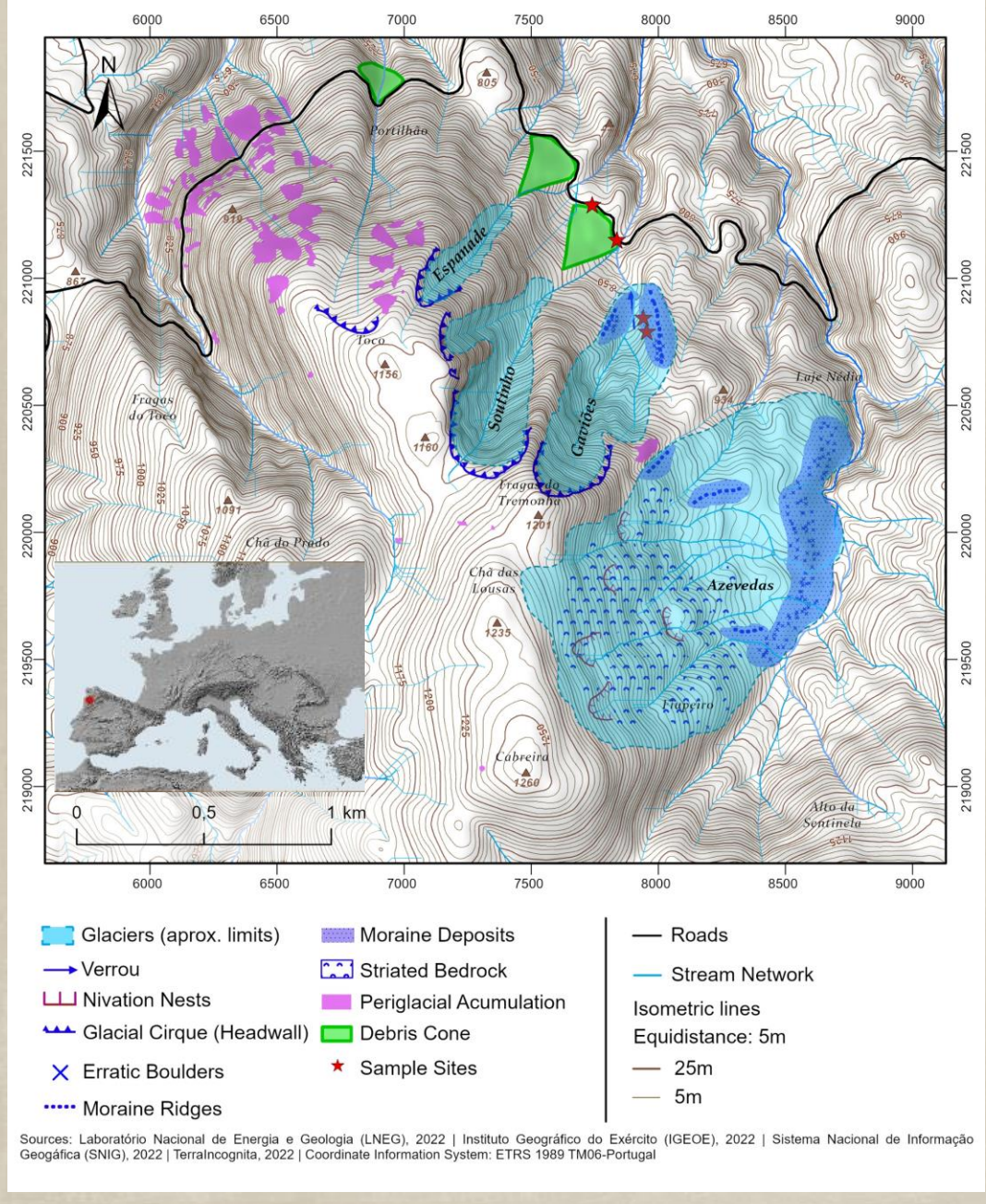
- Glacial landforms and sediments that are the product of past glaciations can provide geomorphologists with meaningful information on the nature of processes that are occurring in modern glaciers.

- Specifically, this research objectives are:

a) To explain the genesis of late Quaternary moraines and diamictons present in two glacial valleys in the Serra da Cabreira Mountains of northwestern Portugal using till macrofabric and grain size analysis.

b) To reconstruct the ice and meltwater flow directions in these two valleys at least during the local LGM.

Serra da Cabreira Mountains, NW Portugal



- This mountain range is located in northwestern Portugal in the Iberian Peninsula northwest, SW Europe (41°39′ N, 8°03′ W). These Atlantic mountains are the lowest in elevation (1260 m) glaciated range in the Iberian Peninsula. The Paleo-ELA was around 1,000 m.

- During the local LGM they were home to small valley glaciers approximately 1.7 km (Azevedas), 1.1 km (Gavioes), 0.8 km (Soutinho) and 0.6 km (Espanade) long with ice thickness reaching more than 60 meters in several locations.

- Exposures on lateral moraines and glacial diamictons were analyzed on the Gavioes and Soutinho valleys.

Gavioes Valley and Lateral Moraine

Gavioes Valley and Lateral Moraine

Gavioes Valley and Lateral Moraine

Glacial Sedimentology: Gavioes Lateral Moraine Exp. 1&2

- **Exposure one** is approximately 1.4 m thick and is composed of a massive, poorly sorted (average standard deviation of **2.20ϕ**), light brown, clast-rich, coarse to medium sandy diamicton (average graphic mean of **0.95ϕ** ranging from **0.87ϕ** to **1.02ϕ**).
- **Exposure two** is approximately 2.2 m thick and is composed of a massive, poorly sorted (average standard deviation of **2.23ϕ**), light brown, clast-rich, coarse to medium sandy diamicton (average graphic mean of **0.84ϕ** ranging from **0.82ϕ** to **0.85ϕ**).
- Clasts on both exposures have E–W and SSE-NNW orientations (azimuth values ranging from **86°–154°** on **exposure one** and **73°–160°** on **exposure two**).
- On both exposures, samples are composed of sub-angular to sub-rounded granites. Data from these deposits presents a weak fabric strength (S1 average of **0.58** for both exposures.

Gavioes Lateral Moraine Exp. 1&2 Grain Size Analysis

Valley/Area	Exposure	Unit	Sample	Grain Size %			Sorting (ϕ)	
				Gravela	Sand	Mudb	Graphic Mean	Standard Deviation
Soutinho Valley Deposit	1	1	1	31.00	61.00	8.00	0.35	2.16
Soutinho Valley Deposit	1	1	2	30.00	61.00	9.00	0.45	2.20
Soutinho Valley Deposit Exposure 1 Average				**30.50**	**61.00**	**8.50**	**0.40**	**2.18**
Soutinho Valley Deposit	2	1	1	30.40	61.10	8.50	0.47	2.21
Soutinho Valley Deposit	2	1	2	28.00	62.70	9.30	0.57	2.24
Soutinho Valley Deposit Exposure 2 Average				**29.20**	**61.90**	**8.90**	**0.52**	**2.23**
Gaviões Valley Lateral Moraine	1	1	1	19.60	69.20	11.20	1.02	2.22
Gaviões Valley Lateral Moraine	1	1	2	21.80	68.20	10.00	0.87	2.18
Gaviões Valley Lateral Moraine Exposure 1 Average				**20.70**	**68.70**	**10.60**	**0.95**	**2.20**
Gaviões Valley Lateral Moraine	2	1	1	22.00	68.00	10.00	0.82	2.18
Gaviões Valley Lateral Moraine	2	1	2	23.00	65.00	12.00	0.85	2.27
Gaviões Valley Lateral Moraine Exposure 2 Average				**22.50**	**66.50**	**11.00**	**0.84**	**2.23**

Gravel[a] = Pebbles + Granules

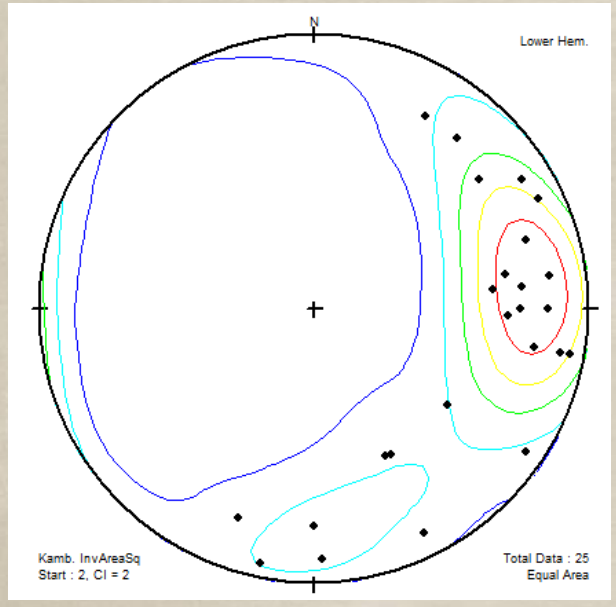
Mud[b] = Silt + Clay

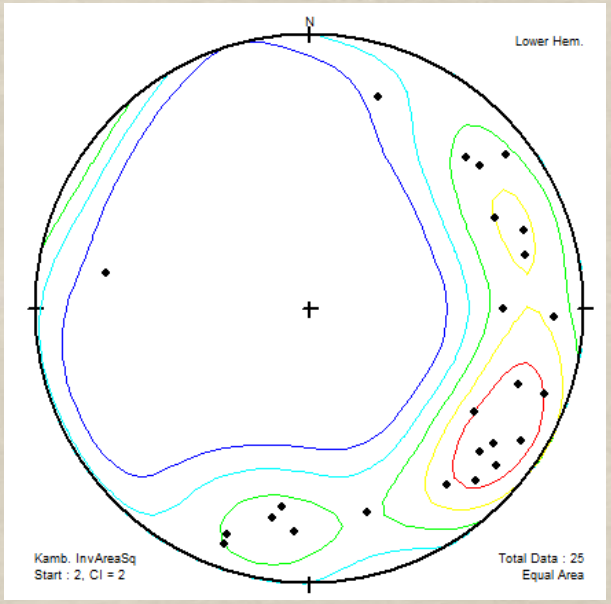
Gavioes Lateral Moraine Exp. 1&2 Till Macrofabric Analysis

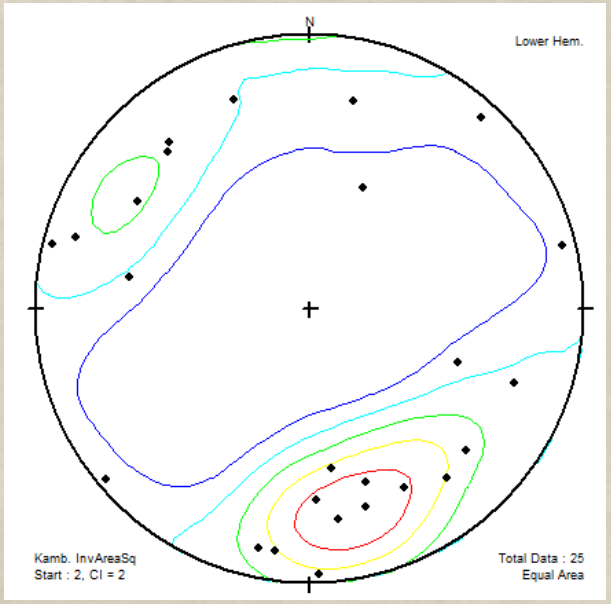
Valley/Area	Exposure	Unit	Sample	S1	S3	Eigenvector V1	
						Azimuth	Plunge
Soutinho Valley Deposit	1	1	1	0.5203	0.1333	199	40
Soutinho Valley Deposit	1	1	2	0.4128	0.2532	220	20
Soutinho Valley Deposit	1	1	3	0.5529	0.0712	213	5
Soutinho Valley Deposit Exposure 1 Average (75 clasts)*				**0.4953**	**0.1525**	**211**	**22**
Soutinho Valley Deposit	2	1	1	0.4890	0.1127	71	9
Soutinho Valley Deposit	2	1	2	0.5337	0.0864	72	2
Soutinho Valley Deposit	2	1	3	0.5604	0.1499	204	21
Soutinho Valley Deposit Exposure 2 Average (75 clasts)*				**0.5277**	**0.1163**	**98**	**20**
Gaviões Valley Lateral Moraine	1	1	1	0.6322	0.0375	86	24
Gaviões Valley Lateral Moraine	1	1	2	0.5542	0.0510	111	21
Gaviões Valley Lateral Moraine	1	1	3	0.5537	0.1599	154	10
Gaviões Valley Lateral Moraine Exposure 1 Average (75 clasts)*				**0.5800**	**0.0828**	**118**	**21**
Gaviões Valley Lateral Moraine	2	1	1	0.6503	0.0294	99	23
Gaviões Valley Lateral Moraine	2	1	2	0.5510	0.1145	73	26
Gaviões Valley Lateral Moraine	2	1	3	0.5476	0.1034	160	6
Gaviões Valley Lateral Moraine Exposure 2 Average (75 clasts)*				**0.5829**	**0.0824**	**111**	**22**

*Averages are taken from all clasts in each site.

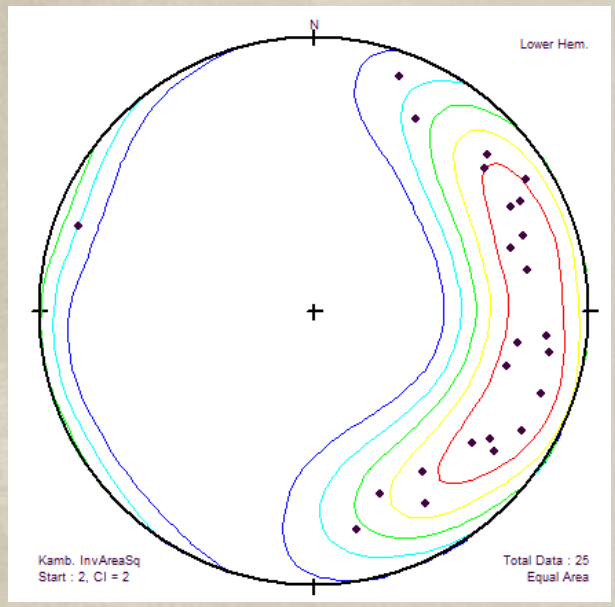
Gavioes Lateral Moraine Exp. 1 Till Macrofabric Analysis

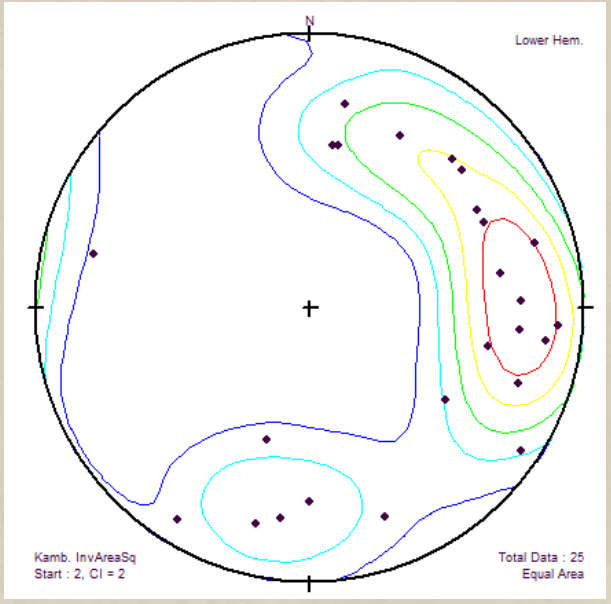


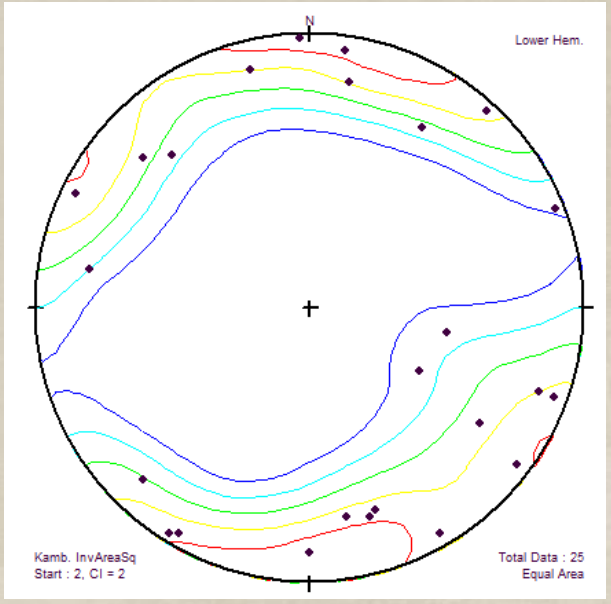




Gavioes Lateral Moraine Exp. 2 Till Macrofabric Analysis







Soutinho Valley Cirque

Soutinho Valley Cirque and Debris Cone

Glacial Sedimentology: Soutinho Diamictons Exp. 1&2

- **Exposure one** is approximately 1.2 m thick and is composed of a massive, poorly sorted (average standard deviation of **2.18ϕ**), light brown, clast-rich, coarse sandy diamicton (average graphic mean of **0.40ϕ** ranging from **0.35ϕ** to **0.45ϕ**).
- **Exposure two** is approximately 1.8 m thick and is composed of a massive, poorly sorted (average standard deviation of **2.23ϕ**), light brown, clast-rich, coarse sandy diamicton (average graphic mean of **0.52ϕ** ranging from **0.47ϕ** to **0.57ϕ**).
- Clasts on both exposures have SSW–NNE and WSW-ENE orientations (azimuth values ranging from **199°–220°** on **exposure one** and **71°–204°** on **exposure two**).
- On both exposures, samples are composed of sub-rounded granites. Data from these deposits presents a very weak fabric strength (S1 averages of **0.49** and **0.52** for **exposures 1** and **2** respectevely.).

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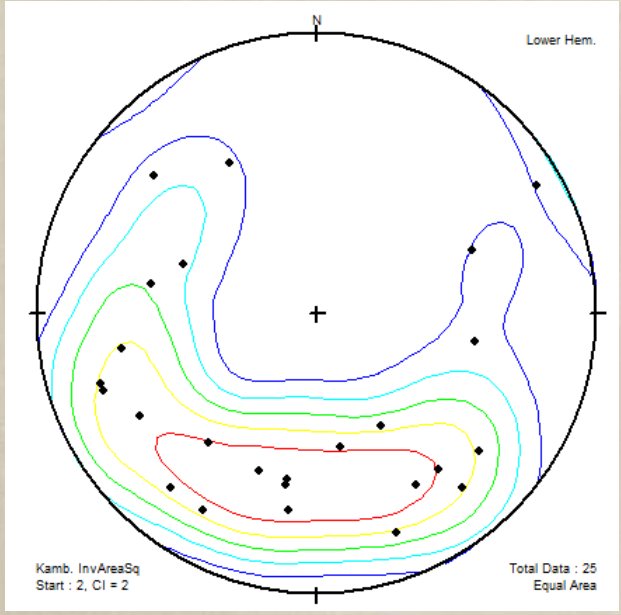
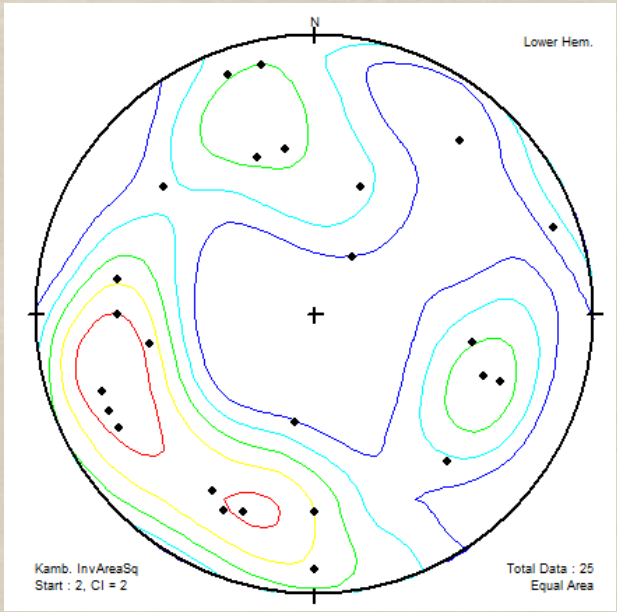
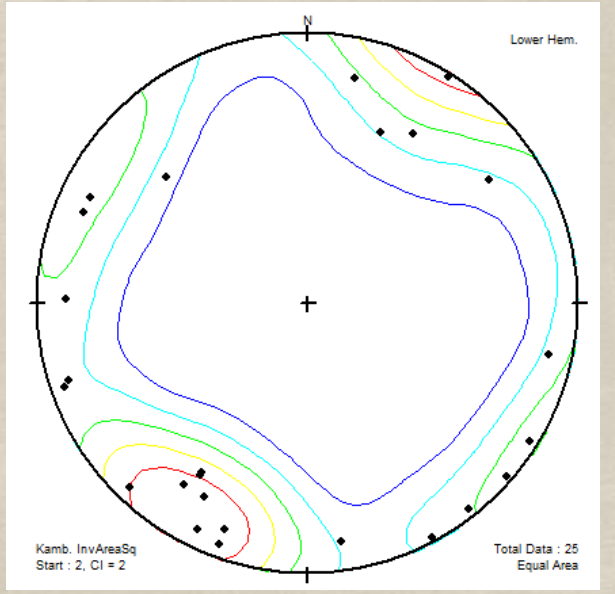
Soutinho Diamictons Exp. 1 Till Macrofabric Analysis







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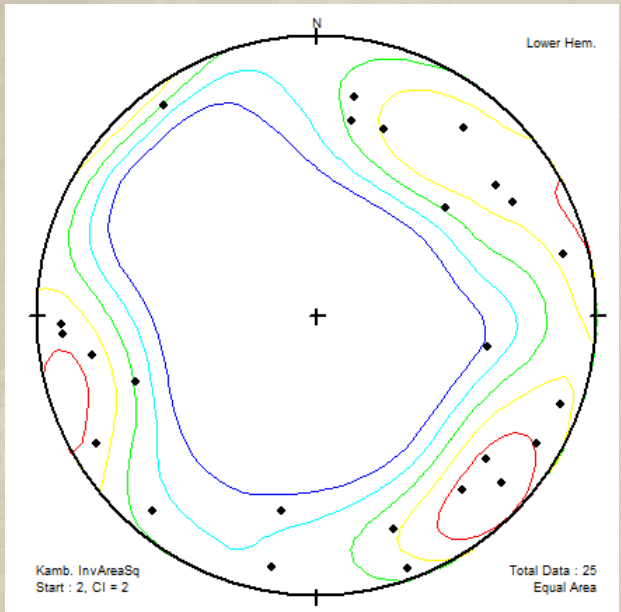
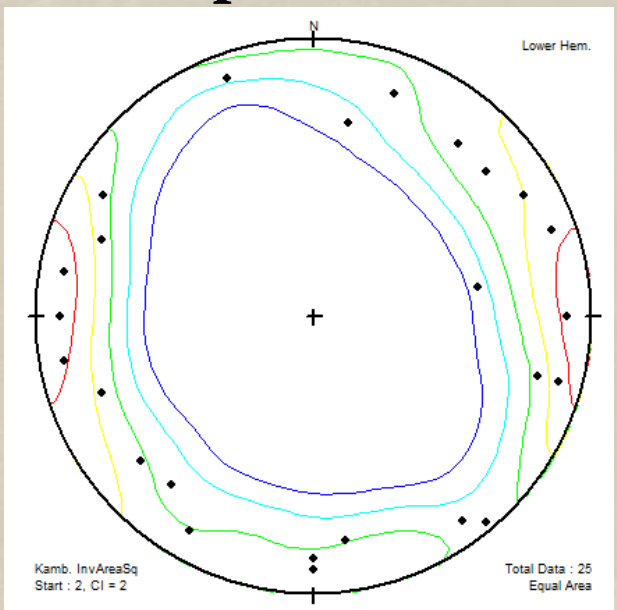
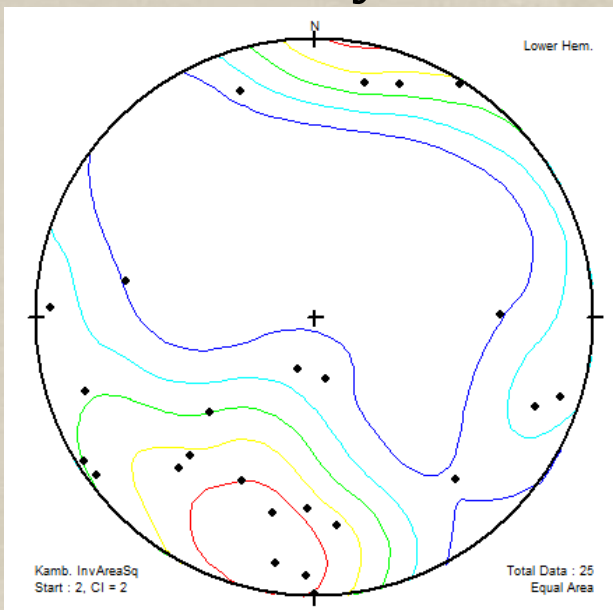






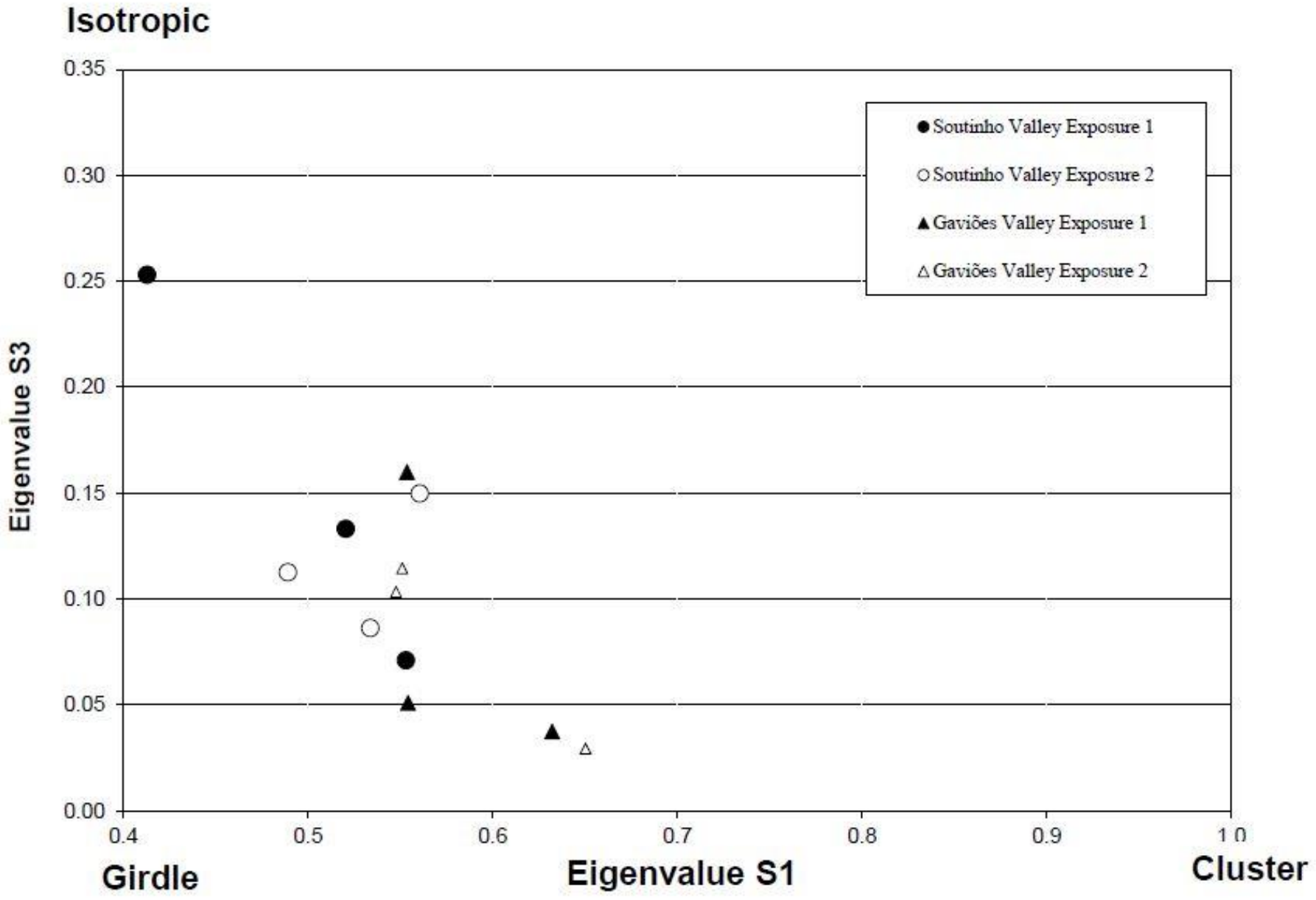
Interpretation

- The sedimentology of the Gavioes Valley lateral moraine and the Soutinho Valley deposits reveal the presence of at least two types of glacial diamictons.

- The poorly sorted, clast-rich, coarse to medium sandy diamicton with poorly oriented clasts and weak fabric strength present in Gavioes Valley moraine is interpreted to be **supraglacial melt-out till** (**or ablation till**).

- The poorly sorted, clast-rich, coarse sandy diamicton with very poorly oriented clasts and very weak fabric strength present in Soutinho Valley is interpreted to be a **glacial debris flow.**

Serra da Cabreira Mountains Macrofabric Analysis



Conclusion

- Till macrofabric and grain-size analysis data from the Serra da Cabreira Mountains revealed the presence of two types of glacial diamictons deposited during several stages.

- During a first stage (likely before and during the local LGM), glacial ice advancing from the Gavioes and Soutinho cirques reach its maximum extent position.

- Subsequent stages of glacial stability followed by recession (likely during and at the end of the local LGM) deposited the supraglacial melt-out till (ablation till) present in the Gavioes Valley lateral-terminal moraine.

- The glacial debris flows deposits present in the Soutinho Valley are representative of glacial and postglacial mass wasting activity.

- Glacial ice disappeared from the Cabreira Mountains before 14,056 Cal yr BP as observed in the neighboring and higher Serra do Geres Mountains (Santos unpublished data).


Questions?
Thank You