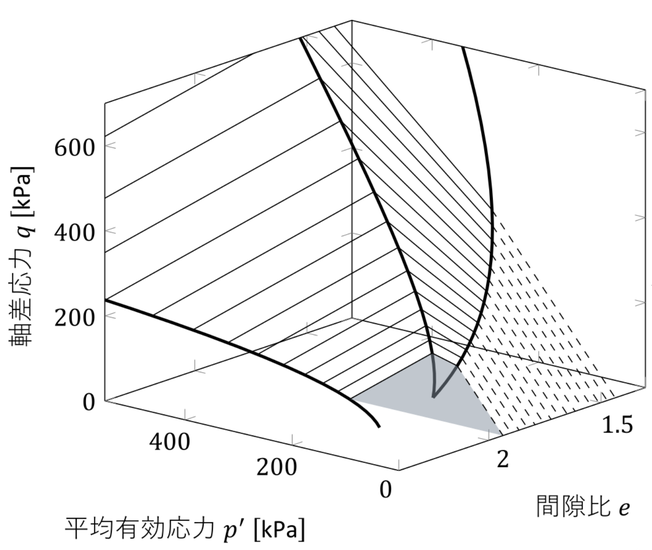
Difference in slope on state-boundary surface between artificial pumice and Ta-d

人工軽石とTa-d のstate-boundary surface の傾きにおける差異

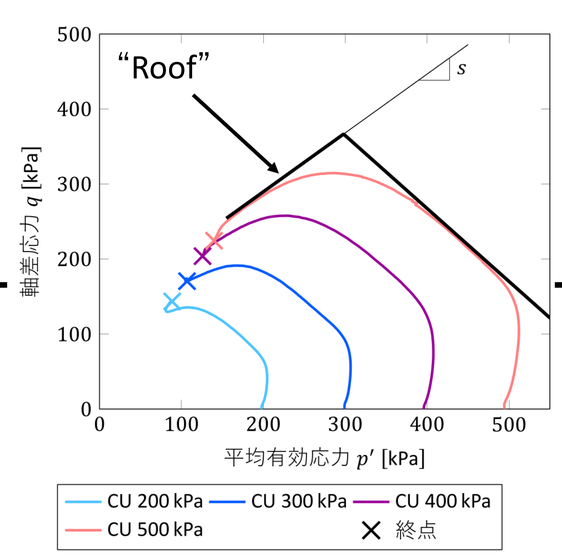
軽石は，斜面崩壊などの地盤災害の原因としてしばしば指摘される材料です．一方，土の力学挙動の議論の多くで，平均有効応力p'・軸差応力q・間隙比eがパラメーターとして用いられます．ここで，p'–q–e空間で，土の応力状態(p', q, e)の存在範囲を制限する曲面のことをstate-boundary surface (SBS) と呼びます．既往研究では，軽石の破砕性とSBSの形状との関係について，人工軽石のみが議論されていました．本研究では天然の軽石Ta-dについて同様に議論し，次の仮説を得ることができました．つまり，間隙比が大きい領域では人工軽石と同様の破砕性土的挙動を示し，小さい領域では非破砕性土的挙動を示す，というものです．

Pumice soil is often a significant factor in ground disasters such as slope failures. The mechanical behaviour of soil is typically expressed using three parameters: mean effective stress p', deviator stress q, and void ratio e. In three-dimensional p'–q–e space, the state-boundary surface (SBS) defines the limit within which the soil's stress state (p', q, e) is confined. Previous research focused on artificial pumice and discussed the relationship between its crushability and the shape of its SBS. This research focuses on natural pumice, Ta-d, and hypothesises that Ta-d behaves like crushable soil, as observed in artificial pumice, when the void ratio is large, and behaves like uncrushable soil when the void ratio is small.

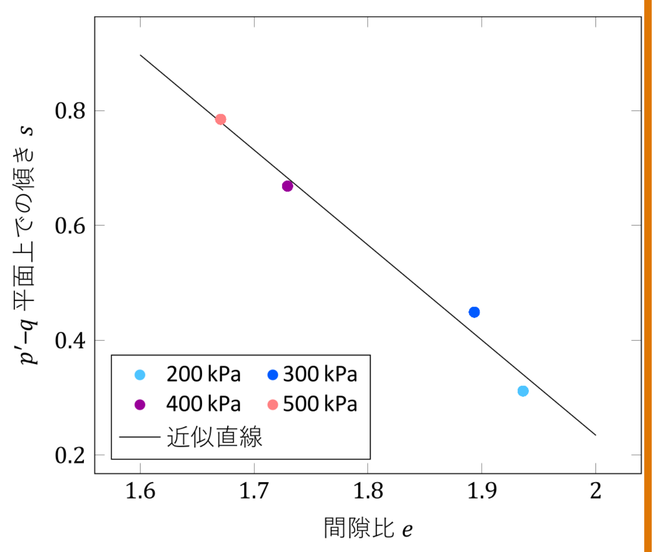
Artificial Pumice (Previous Study)



Obtain an SBS by fitting the undrained ‘roofs’
→ Any undrained state path cannot deviate from it

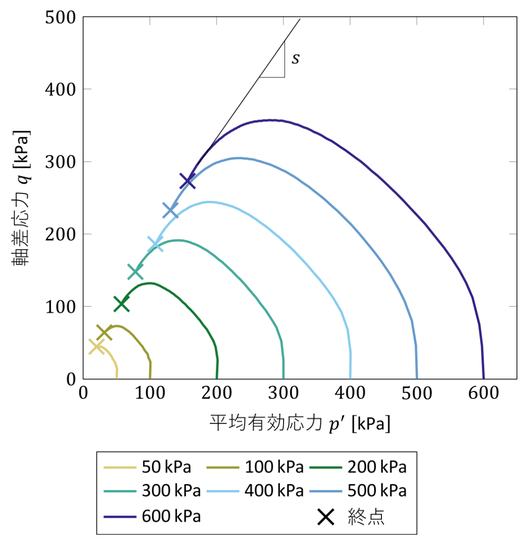


An undrained stress path cannot increase q endlessly because p'changes → it hits the ‘roof’

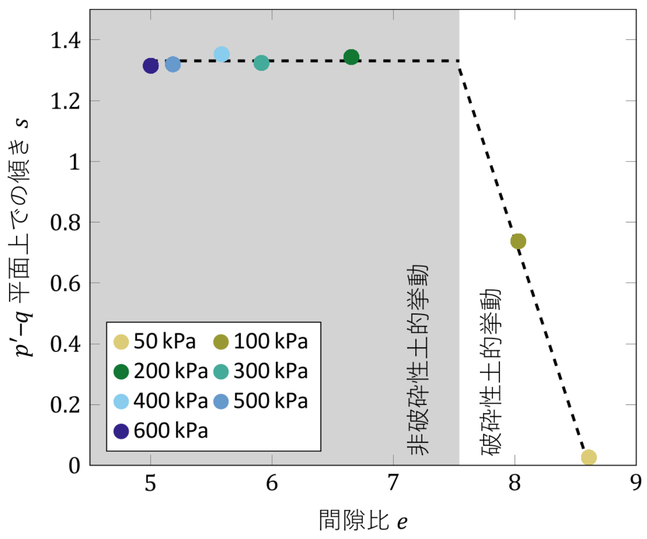


The relationship between the slope (of the stress path [i.e., SBS]) s and e is linear

Natural Pumice – Ta-d



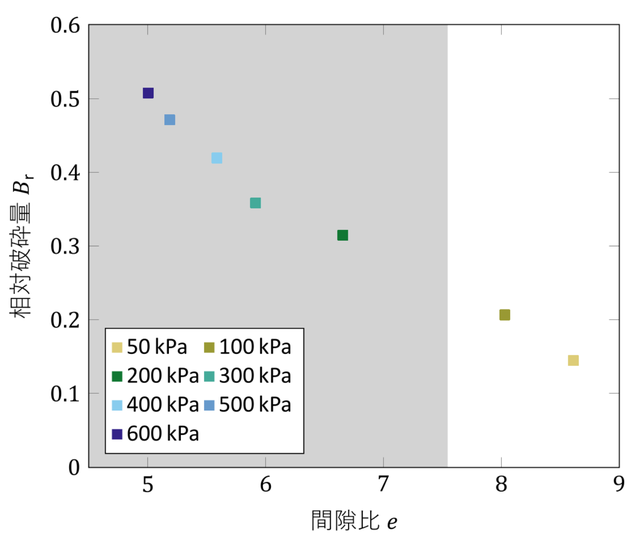
No.	拘束圧 [kPa]	e_{BC}	B_r	$e_{a_{end}}$ [%]
1	50	9.25	0.145	10
2	100	9.33	0.207	10
3	200	8.68	0.315	11
4	300	8.56	0.358	11
5	400	8.60	0.419	11
6	500	8.61	0.471	11
7	600	8.81	0.508	11



The relationship between slope s and e can be interpreted as a combination of two linear relationships, which can be described by the following hypothesis:

1. $e > 7.5$: behaviour like crushable soil, as observed in artificial pumice
2. $e < 7.5$: behaviour like **un**crushable soil

Particle breakage saturates around $e = 7.5$ and does not increase for $e < 7.5$?



* B_r: an index for particle breakage
Particle breakage (in the last phase of the shearing) does NOT change around $e = 7.5$.
→ B_r cannot support the hypothesis
→ Can other parameters support it?
like particle size distribution:
- Just before shearing
- When q reaches its peak

(in future research…)

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