LAND SUBSIDENCE REBOUND CAPABILITY

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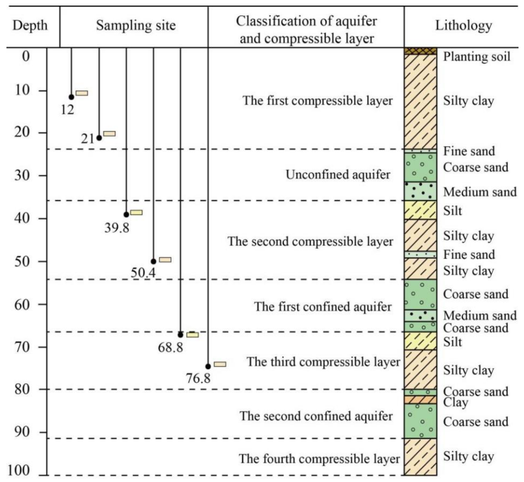
INTRODUCTION

- Groundwater withdrawal rates are at an all-time high
  - Due to increased agricultural need
- When extraction rate exceeds infiltration rate (replenishing) ground subsidence occurs
- The compression from subsidence can be characterized into three main layers that determine rebounding
- The first layer experiences greatest deformation
  - Best ability for rebound
- Second and third have more gradual and long-term subsidence
- The subsidence index, C_w, describes the soil compressibility during groundwater withdrawal
- This index could point to areas more vulnerable to permanent groundwater subsidence
- It also correlates depth of aquifers with pressure to account for “recovery periods” of land subsidence

METHODS

- Interpreting the data found on soil type and depth and subsidence index
- Correlate this to soil types and aquifer depths
- Determine the possibly recovery time of land subsidence in this region using this index

RESULTS



Samples	Experimental deformation (mm)	Theoretical deformation (mm)	Δu_1 (kPa)
Sample 1	0.250	0.298	88–0
Sample 2	0.225	0.220	100–0
Sample 3	0.078	0.072	100–0
Sample 4	0.063	0.061	100–0
Sample 5	0.032	0.039	100–0
Sample 6	0.043	0.048	100–0

Sample	Total stress (kPa)	Δu_1 (kPa) 0~100	Δu_2 (kPa) 100~200	Δu_3 (kPa) 200~400	Δu_4 (kPa) 400~600	Recovery process
Sample 1	240	88–0	--	--	--	0–88
Sample 2	448	176–76	76–0	--	--	0–176
Sample 3	844	361–261	261–161	161–0	--	0–361
Sample 4	1013	464–364	364–264	264–64	--	64–464
Sample 5	1456	645–545	545–445	445–245	245–45	45–645
Sample 6	1570	723–623	623–523	523–323	323–123	123–723

Sample	Initial void ratio e_0	Void ratio e	Subsidence index C_w (kPa^{-1})
Sample 1	0.77	0.7523	2.01E-4
Sample 2	0.51	0.4964	1.36E-4
Sample 3	0.52	0.5152	4.74E-5
Sample 4	0.66	0.6558	4.18E-5
Sample 5	0.53	0.5280	1.96E-5
Sample 6	0.64	0.6372	2.82E-5

CONCLUSION

- The data shows that the lower depths of the water table the longer the recovery time
  - There is a corresponding increase in pressure with depth that does not allow for uncompressing of soil
- After the sampling points were past the unconfined aquifers, the second and third characterized layers there was less deformation but more pressure
  - This pressure led to the longer rebound time of subsidence
- If this data corresponds to conditions in California, when the water table begins to increase in depth there is more corresponding pressure that forces a longer rebounding period
  - This is where the irreversible damage occurs as the increase in pressure destroys compression of soil and allows limited rebound

BIBLIOGRAPHY

- Cao, Y., Wei, Y., Fan, W., Peng, M., & Bao, L. (2020). Experimental study of land subsidence in response to GROUNDWATER withdrawal and recharge in Changping District of Beijing. *PLOS ONE, 15*(5). doi:10.1371/journal.pone.0232828