

- ▶ TOSHIMICHI USUBA, *Choiceless set-theoretic geology*.  
Faculty of Science and Engineering, Waseda University, Tokyo 100-0003 Japan.  
*E-mail:* [usuba@waseda.jp](mailto:usuba@waseda.jp).

The set-theoretic geology, which was initiated by Fuchs-Hamkins-Reitz, is a study of the structure of all ground models of the universe. The standard geology is assuming the axiom of choice, but in the current set theory, the forcing method over choiceless model become a common tool. In this talk, we try to develop the set-theoretic geology without the axiom of choice. We show that if the universe satisfies some downward Loewenheim-Skolem type property holds, then every ground model is uniformly definable, and such a property follows from large cardinal axioms.