TERRESTRIAL ANALOG OF BURIED AND BROKEN OLD KARST LIMESTONE BRECCIAS WITH MANY CAVES TO THE MOON AND MARS. Yasunori Miura, Yamaguchi University, Chuou 4-1-23, Yamaguchi753-0074, Japan (dfb30@yamaguchi-u.ac.jp; moonyas@hotmail.com)

Introduction: Detailed analyses of terrestrial analog of limestone blocks with buried and broken caves are inevitable for next planetary exploration. The main purpose of this paper is to elucidate terrestrial analog of buried and broken old Karst limestone blocks with caves to apply the Moon and Mars etc. [1-4].

Akiyoshi limestone blocks as terrestrial analog: The Akiyoshido (cave) and Akiyoshidai (plateau) are located at Mine-City, Yamaguchi Prefecture, western Honshu (main) Island in Japan (Fig.1a). Age of Akiyoshi limestone is 350Ma to 250Ma in Paleozoic period. The size is about 130 km^2 (13,000ha) on plateau at altitude of 200m to 400m. Among 450 limestone caves, main Akiyoshido Cave is huge as 420,000 m^3, long as 10km length, and took 300,000 years to form recently (Fig.1b). Karst tableland of Akiyoshi district is a landscape topography formed by the dissolving of carbonate limestone or marble by water, when surface or ground water becomes weakly acidic and reacts chemically with atmospheric or soil carbon dioxide. The Akiyoshi Karst is found as caves, sinkholes (dolines), vertical shafts, disappearing streams, and springs, to complex underground water system.

Reservoir of carbon as circulation system: Calcium carbonates (calcite or limestone) are main reservoirs of carbon in the water planet of the Earth. Total carbon content in global circulation system is 50,000GtC (Gt=10^9t). Almost all carbon (i.e. 94% of carbon) can be found in sea water, which suggests main circulation system of CO_2 including formation of limestone. Carbon content of atmosphere and land life is ca.750GtC and 2,200GtC, respectively. Rapid (short range) cyclic carbon through life organic compounds is only 61GtC. Carbon content of Akiyoshi district showing "Karren (a flock of sheep by impact breccias)" (Fig.1c) is estimated from limestone as 42GtC.

New geological results of the Akiyoshi Plateau: The Akiyoshi limestones which have many fossils of Carboniferous to Permian Periods, were created in southern Equator about 350 million years ago (Fig.1d). As stopping sedimentation of Paleozoic limestone in shallow sea water, original Akiyoshi limestones were strongly broken to survive under crust ground (with old China blocks) by strong catastrophic event at Permian end (maybe 250 million years ago) , where almost all sea living species (97%) were disappeared as large mass extinction. After transporting to northern part of Asia with two China continents blocks (more than 5,000km), western part of Honshu island of Japan was separated from big China continent where the Akiyoshi limestone blocks are isolated to form the Sea of Japan by Takamatsu impact event about 15 million years ago. Strong shock wave energy to form Japanese islands (mainly western part) makes transportation of buried Akiyoshi limestone blocks with deeper Cretaceous granite up to the surface to form caves by weathering. The Akiyoshi limestone rocks are remnants of stopped carbon cycle at the Permian end, and started again carbon cycle later and followed water process.

Planetary significance of the Akiyoshi breccias: From planetary exploration, the Akiyoshi limestone breccias are significant as follows: 1) Original coral reef limestones are stopped and buried by impacts on sea-water to transport and lifted to the surface by impact to be weathered. These type breccias will be found with caves on fluid-bearing planetary bodies.
2) Wide limestone blocks in U.S.A. (Carlsbad and Mammoth) formed regularly under sea-water, have few irregular feature which is found on water Earth.

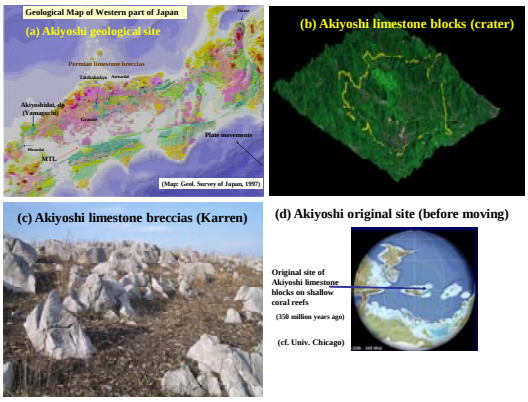

Fig.1. (a) Geological site of the Akiyoshi blocks. (b) The Akiyoshi limestone block remained as crater-like feature. (c) Wide Akiyoshi breccias Karren. (d) Original site of the Akiyoshi coral reefs near the Equator.

Summary: The results are summarized as follows: 1) Old limestones are stopped and buried by impacts to transport and lifted to the surface by impact to form caves, which will be found with caves on other planetary bodies if fluid phases are existed. 2) Wide and regular limestone blocks formed regularly under seawater, are found on water-rich planet Earth.

References: [1] Kaiho Y. et al. Geology, 29, 815-818. [2] Miura Y. et al. (2004): LPI Contrib., 1197, #2150. [3] Miura Y. (2003): J.Yamaguchi Earth Sci., 50, 13-18. [4] Miura Y. (2006): Akiyoshi Cave Plateau Field Guide (English), 1-16 (ICEM2006).