金瓜石區域次生碳酸鹽礦物之螢光成因分析
Determine the Causes of Fluorescence in Secondary Carbonate Minerals from the Jinguashih Area

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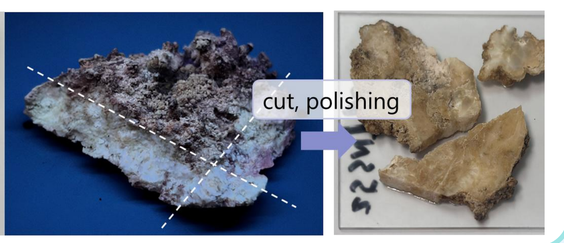
Abstract

This study examines secondary fluorescent carbonate minerals from the Jinguashih area to clarify their fluorescence origins. Fluorescence imaging, Micro-XRF, and Micro-Raman analyses were used to assess fluorescence distribution, chemical composition, and mineral phases. Samples from Taizi Tunnel, BenShan forth tunnel, BenShan fifth tunnel, BenShan sixth tunnel, and Shueinandong were analyzed, with emphasis on strongly fluorescent specimens. Micro-XRF was conducted at the National Museum of Natural Science, Taiwan, and Micro-Raman at Kwansei Gakuin University (KGU), Japan. Results show that fluorescent carbonates are mainly calcite and aragonite. Calcite fluorescence is linked to Mn, Zn, and lattice defects, whereas aragonite fluorescence is related to Sr incorporation. This work provides a preliminary characterization and interpretation of fluorescent carbonates from Jinguashih, offering a foundation for future studies on fluorescence mechanisms and geochemical implications.

Mechanism of Fluorescence

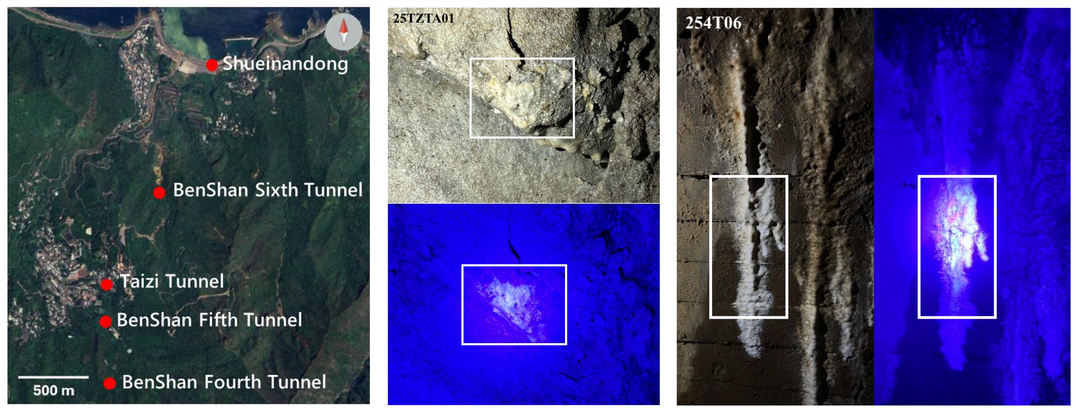
1. Electrons absorb specific energy (UV light) and move to excited state from ground state.
2. Electrons is unstable at the excited state, so it return to the ground state.
3. During this return, energy is released as light; if within the visible range, fluorescence appears.

Fluorescence of carbonate mineral → Impurity elements / Lattice defects



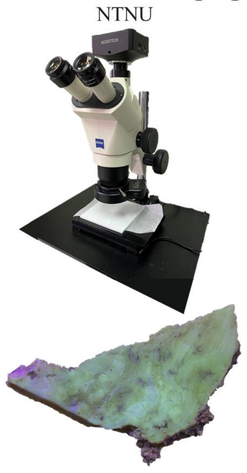
(Fleming, 2016)

Sample collecting and processing



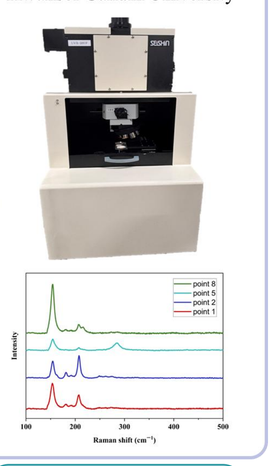
Research Objective and Method

Fluorescent imaging
NTNU



Micro-XRF analysis
National Museum of Natural Science

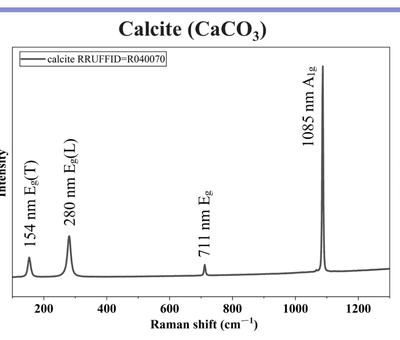
Micro-Raman analysis
Kwansei Gakuin University

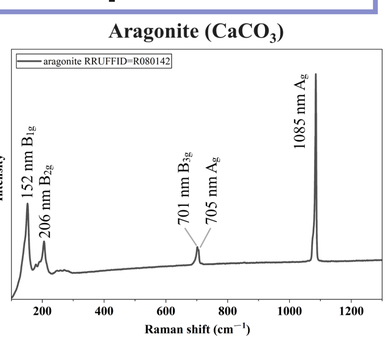


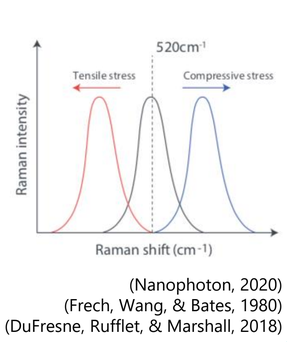
Element distribution → Impurity

Impurity v.s. Lattice defects

Raman spectrum and peak shift







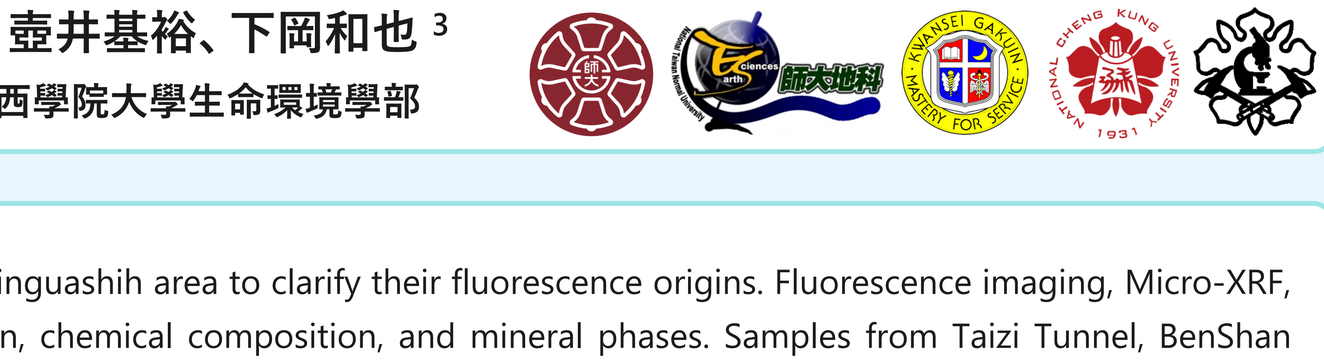
(Nanophoton, 2020)
(Frech, Wang, & Bates, 1980)
(DuFresne, Rufflet, & Marshall, 2018)

Result

calcite with orange fluorescent color

orange fluorescent color	1
green fluorescent color	2, 3, 4

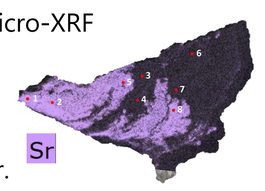
The cause of fluorescence due to lattice defect

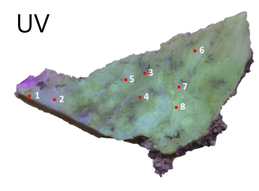


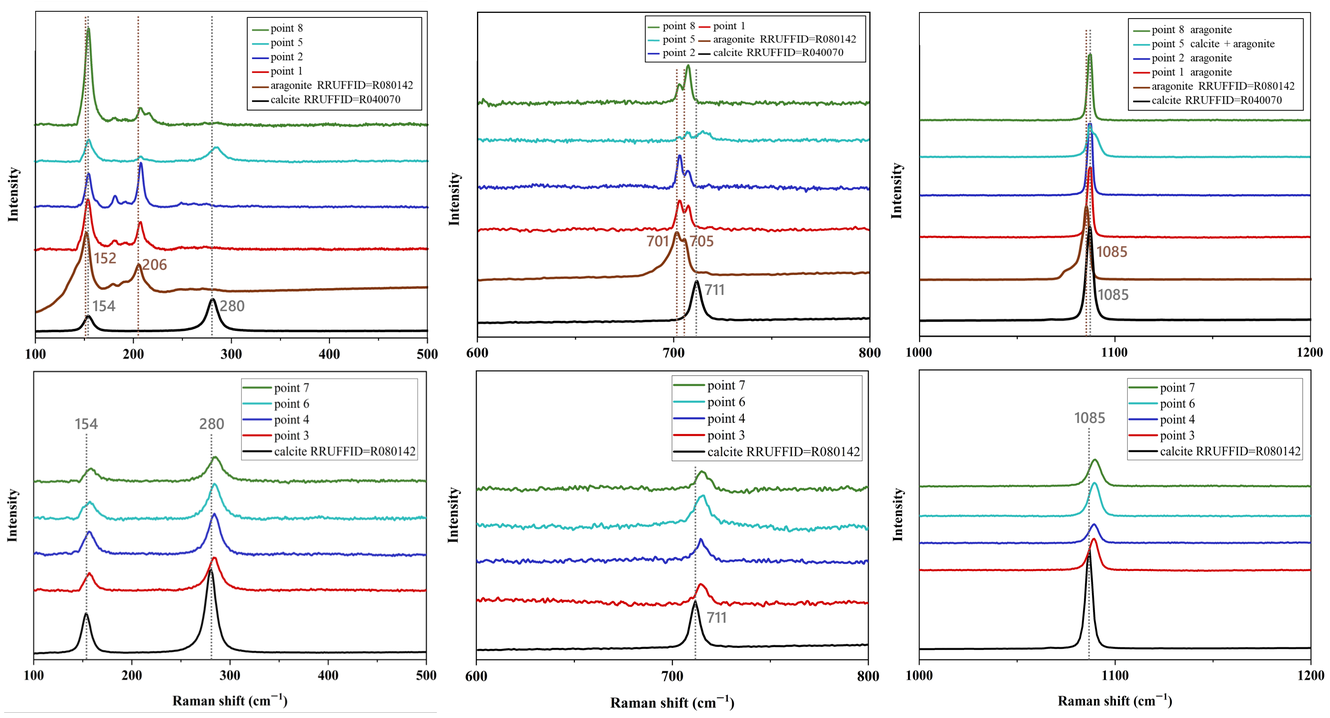
calcite + aragonite with Sr impurity

calcite	1, 2, 8
aragonite	3, 4, 6, 7
calcite+aragonite	5

The cause of fluorescence due to impurity element of Sr.



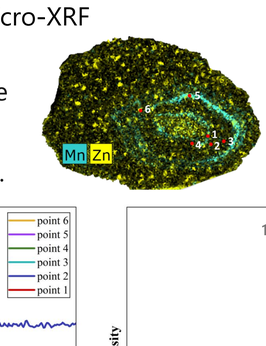


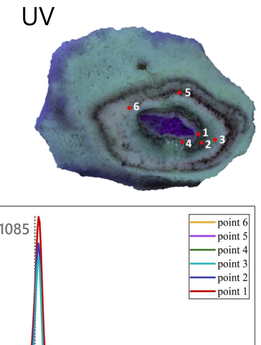


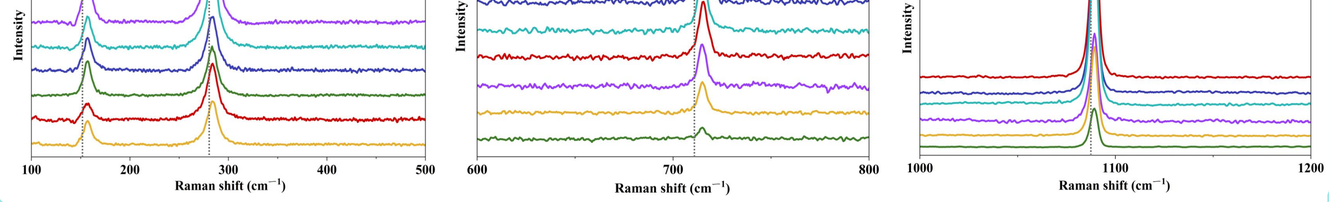
calcite with Mn and Zn impurity

Mn impurity	1, 5
Zn impurity	4, 6
None	2, 3

The cause of fluorescence due to lattice defects and impurities such as Mn and Zn.







Conclusion

1. The secondary carbonate mineral in Jinguashih are calcite and aragonite.
2. The cause of fluorescence in calcite are due to lattice defect and contain impurity element such as Mn and Zn.
3. The cause of fluorescence in aragonite is due to impurity element of Sr.

Acknowledgements

Thanks to Chia-Chun Huang for fieldwork assistance, and to Mr. Han for support with the Raman experiments.

Reference