方解石双晶の応力歪み統合解析：理論
Combined stress and deformation analyses of heterogeneous calcite twin data: Theory

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機械的双晶の形成により，方解石の結晶は双晶ラメラにそって単純剪断をこうむる．この原理にしたがって双晶形成による方解石の変形量を見積もることができ(Conel, 1962)，多結晶体では平均的な歪みテンソルを見積もることもできる(Groshong, 1972)．しかしそうした従来の方法では，複数の変形時階をへて形成された双晶から，各時階の変形テンソルを分離することは難しい．

そこで今回，複数時階をへた方解石多結晶から複数の応力を分離する方法に，Conel (1962)の歪み解析を組み合わせ，応力と歪みそれぞれを分離する方法を考えた．すなわちまず，双晶の方向データを5次元空間の単位球上の点で表現し，この球面上のファジークラスター解析により，複数の応力を分離・把握した．それにより各データがどの応力で説明できるかを表すメンバーシップが得られるので，それを使って双晶ラメラを応力時階ごとにファジー分類すれば，時階ごとの変形テンソルを計算することができる．このポスターでは，理論的部分を解説する．

キーワード：応力インバージョン、歪み解析、機械的双晶、ファジークラスター解析
Keywords: stress inversion, strain analysis, mechanical twin, fuzzy clustering

方解石双晶の応力歪み統合解析：天然データへの適用および断層解析との比較

Combined stress and strain analyses of calcite twins: Application to a natural data set and comparison with fault-slip analysis

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方解石双晶の応力歪み統合解析を天然サンプルに適用し，サンプリング地点周辺の小断層から検出された応力と比較した．サンプルは外房松ヶ鼻付近の天津層の約11Maの層準（亀尾ほか, 2002）で採取した方解石脈である．

応力解析の結果，正断層型に近い応力と正断層型と横ずれ型の中間的な応力が検出された．応力比はそれぞれ0.55と0.82．臨界分解剪断応力で規格化した無次元差応力はそれぞれ5.3と3.7であった．どちらの応力もσ3軸はWNE-ESEであった．2つの応力それぞれで，対応する双晶から算出された歪みの主軸は応力主軸に近かった．相当歪みはそれぞれ4.4%と3.6%であった．双晶から検出された２つの応力に近い解が，小断層群からも得られた．すなわち，双晶による応力歪み解析と小断層解析のいずれからも，調和的な解が得られた．

キーワード：方解石双晶、応力解析、歪解析
Keywords: Calcite twin, Stress inversion, Strain analyses

Exploring variations of earthquake moment on patches with heterogeneous strength

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Finite-fault inversions show that earthquake slip is typically non-uniform over the ruptured region, likely due to heterogeneity of the earthquake source. Observations also show that events from the same fault area can have the same source duration but different magnitude ranging from 0.0 to 2.0 (Lin et al., 2016). Strong heterogeneity in strength over a patch could provide a potential explanation of such behavior, with the event duration controlled by the size of the patch and event magnitude determined by how much of the patch area has been ruptured. To explore this possibility, we numerically simulate earthquake sequences on a rate-and-state fault, with a seismogenic patch governed by steady-state velocity-weakening friction surrounded by a steady-state velocity-strengthening region. The seismogenic patch contains strong variations in strength due to variable normal stress. Our long-term simulations of slip in this model indeed generate sequences of earthquakes of various magnitudes. In some seismic events, dynamic rupture cannot overcome areas with higher normal strength, and smaller events result. When the higher-strength areas are loaded by previous slip and rupture, larger events result, as expected. Our current work is directed towards exploring a range of such models, determining the variability in the seismic moment that they can produce, and determining the observable properties of the resulting events.

Keywords: Earthquake Dynamic, Earthquake Source

Discrete element simulation of faulting in a subduction zone

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The stress field, fault pattern, and earthquake distribution in an accretionary prism are linked to the topography and geometry of the subducting slab. The influence of underthrust Seamounts, in particular, is now well documented. However, the faulting mechanisms driven by the slab geometry are still incompletely understood. Here, we simulate the effects of slab interface geometry (i.e., smoothness, bending, and subduction angle) on the deformation of the accretionary wedge using the Discrete Element Method (DEM), a technique now proven to be reliable in modelling dense granular flow, rock deformation, fault propagation and folding. We explore how faulting and deformation are related to slab geometry along the Sumatran section of the Sunda megathrust. We validate the credibility of our model by comparing the results with GPS measurements from the Sumatran Tectonic Geodesy Array (SuGAr) on the forearc islands, the Sumatra fault Monitoring network (SuMo) on Sumatra Island and geophysics expedition from the Mentawai Gap - Tsunami Earthquake Risk Assessment project (MEGA-TERA). Spatial patterns of seismic distribution and mechanisms are compared to predictions from our physically-based model. Most of the earthquakes appear to take place near subducting seamounts. Such earthquakes may contribute to seismic hazard along segments of the subducting plate.

Keywords: SUBDUCTION, SIMULATION

Horizontal stress profiles reconstruction based on elastic properties and natural fractures' characteristics. NanTroSEIZE case study.

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A great amount of data acquired for IODP expedition sites in the Nankai Trough area made it possible to use a previously proposed approach of utilizing wellbore imager data to estimate the horizontal stresses distribution along wells' trajectories. Horizontal stress profiles were reconstructed for site C0002 with a decent accuracy (being in consistence with studies of other researchers) and the same profiles were estimated for several other sites in the area.
A reconstruction of stress profiles for site C0002 was based on data provided by the leak-off tests (LOTs) performed during expedition 338. The inverse problem of stress reconstruction was solved by introducing a relationship between stress field and fractures observed at the azimuthal focused resistivity images provided for the well. Although the initial formulation of the applied approach had requested a study on both resistivity and ultrasonic imagers, it has been found out that some estimations may be carried out on a single image data with extra investigations of gamma-ray, resistivity and velocity logs with the use of composition of the medium (mineralogy and organic matter). A corresponding research was carried out for this site to estimate the horizontal stresses profiles which proved to be consistent with the LOT results and breakout model.
In spite of absence of data on minimum horizontal stress magnitude from LOT performed for other sites in the area there still remains data on the fracture orientations from wellbore imagers –crucial input data for the applied approach. This approach was modified to provide some estimations on the stress profiles without direct measurements of minimum horizontal stress. The resultant stress profiles have a wider range of possible magnitudes compared to C0002 site although they still contain valuable information regarding the in-situ stress state in the area.
The modifications of the approach applied in the case, results of the stress profiles reconstruction and their comparison with other researchers' results are presented in the paper.

Keywords: Geomechanics, In-Situ Stress, NanTroSEIZE, Logging While Drilling

