

スキャナー, CAMSIZER, 土色計および帯磁率測定を用いた簡便な砂組成解析手法の試み

An experimental method for simple and easy sand composition analysis using a digital color scanner, a CAMSIZER, a soil c

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1. はじめに 砂は礫とシルトの中間(粒径が $62.5 \mu m \sim 2mm$)の碎屑粒子径を示し, 我々の近接した生活環境, 例えば海浜, 砂丘や河川敷には必ず存在する. 従来の砂粒子の研究法としては, 篩分け法, エメリー管法や沈降天秤法などによる粒度分析, 薄片や重鉍物を使った組成解析などが行われてきているが, 総じて砂組成を分析するには手間と時間がかかり, 経験によってデータの質が左右される傾向がある. しかし近年の科学技術の発展により, 正確かつ短時間に, 再現性が高く精度の良い堆積物物性値計測を行うことが可能になっている. 本発表では, これら最近の分析手法を組み合わせ, 茨城県久慈河流域の河川砂を例として簡便な砂組成解析を試験的に試みたので, その概要を報告する

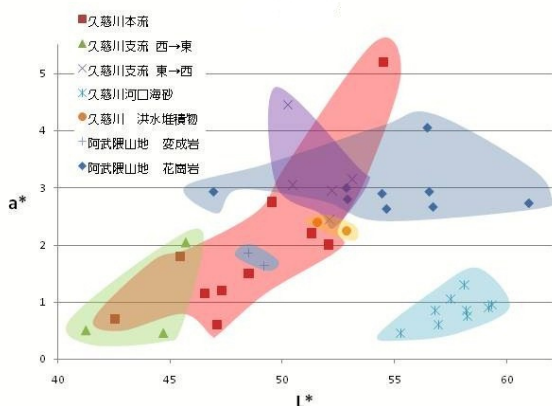
2. 調査地域 茨城県内にある久慈河流域は, 既に産総研によって1/20万シームレス地質図が公表され, 支流ごとの地質の分布が明らかになっており, しかも白亜系から完新統, 堆積岩, 火山岩, 花崗岩など, 日本列島を構成する代表的な地質を網羅していることから, 今回の調査地域に設定した. サンプル地点は久慈川水系の大まかな地質により, A: 久慈川本流, B: 西から東に流れる久慈川支流, C: 東から西に流れる久慈川支流, D: 久慈川河口の海砂, E: 阿武隈山地の変成岩帯, F: 阿武隈山地の花崗岩地帯, G: 里川の7つのグループに区分して行った.

3. 研究方法 (1) デジタル画像による砂粒子の観察: 須藤ほか(2002)に従い, ガムテープを用いて, 厚紙に砂を貼り付け, スキャナー(Canon Pixus iP8100)を用いてデジタル画像をとりこんだ. さらに Adobe Photoshop Elements 10.0を用いて画像処理を行った (2) CAMSIZERによる粒度分析: デジタル画像解析式粒子径測定装置 Horiba CAMSIZERを用いて粒子径測定を行った. この分析結果を スケールに変換した後, Fork and Ward(1957)の式を用い, 中央粒径(Median), 平均粒径(Mean), 分級度(sorting), 歪度(Skewness), 尖度(Kurtosis)を算出した. (3) 彩度・明度測定: 土色計 Minoruta SPAD-503を用い, L^* (明度), a^* , b^* (彩度)の測定を行った (4) 帯磁率の測定: デジタル式帯磁率測定器 Terraplus KT-10を用いて帯磁率の測定を行った.

4. 結論 スキャナーで取り込んだデジタル画像は, 自由に拡大縮小できるため, 粒子形状や鉍物の判別に用いることができた. $L^*a^*b^*$ を用いた散布図は, 砂組成の特徴を示すにあたりたいへん有効であった. 例えば, 里川は阿武隈山地の花崗岩帯と久慈河流域東側の新第三系の間を流れており, 阿武隈山地花崗岩と久慈川支流東 西の間に明瞭なフィールドをつくっていることから, L^* と a^* , L^* と b^* , a^* と b^* を2軸に使った散布図では, 水系や支流毎に砂組成が変化することを明瞭に示すことができた. もちろんこれらは風化や変質による色の変化も考慮しなくてはならない. 帯磁率は火山岩や花崗岩分布域や砂鉄の多い海砂で明瞭に高くなる傾向が読み取れ, 分析手法としては有効と言えよう.

キーワード: スキャナー, CAMSIZER, 土色計, 帯磁率測定, 久慈川, 砂組成解析手法

Keywords: digital color scanner, CAMSIZER, soil color reader, magnetic susceptibility meter, Kuji River, sand composition



Provenance of quartz of sediments along the Yangtze River drainage Provenance of quartz of sediments along the Yangtze River drainage

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ESR is an analytical technique to estimate the amount of oxygen vacancy in quartz formed by natural radiation, whose amount shows positive correlation with the age of the host rock (Toyoda, 1992), whereas the Crystallinity Index [CI] of quartz has information on the physical condition of its formation (Murata and Norman, 1976). These two parameters give us information on the age and the rock type of its host rock characteristics.

The Yangtze River is the longest and largest river originates from the Tibetan Plateau, which has played a significant role in sedimentation and biogeochemical cycle in the drainage area, which is strongly influenced by East Asian summer monsoon. The provenance of the Yangtze River-derived sediments and its impact on the drainage and marginal seas have drawn our attention. Seven samples were collected from the bed of the mainstream and major tributaries along the Yangtze River drainages. Four samples were recovered from the rivers Lasa River, Nianchu River, Yarlung Zangbo River, which all located in the Tibet Plateau. Ten samples were collected from Yangtze River Delta. We extracted the two size fractions (<16 μ m, 16-63 μ m) separated from sediments and analysed ESR signal intensity of E1 center of quartz, and CI.

Our preliminary result revealed that ESR signal intensity values of the River located in the Tibet Plateau are around <0.6, indicating young detrital source. ESR signal intensity values are around <1.5 in the upper and middle Yangtze, suggesting average source age of Mesozoic. The ESR signal intensity values become 4 to 6 in the lower Yangtze, suggesting average source age of Palaeozoic to late Proterozoic. Therefore, the above results of ESR signal intensity show an increasing trend to the downstream along the main stream of the Yangtze River. ESR signal intensity values are different from each other in the Yangtze River Delta, which is around 4-12. Since ESR signal intensity values of Yangtze River are 4 to 6 in the lower Yangtze whereas the values become high (6.8 to 17.9) in the downstream of Dongting Lake (Yoshida, 2010). That means the provenance of the Yangtze River Delta sediments is not just main stream of Low Yangtze. Some major branches draining into the main stream or Dongting Lake drainage could impact on the Yangtze River Delta.

Keywords: Yangtze River drainage, ESR, CI

碎屑性重鉱物の供給源から推定される北部日本における後期白亜紀のテクトニクス Late Cretaceous tectonics in the northern Japan deduced by detrital heavy mineral provenance

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It has been recognized that the Yezo Group, which is distributed in the Hokkaido islands, northern Japan, is regarded as a Cretaceous deposit in forearc area. The provenance of the Yezo Group offers the information of the significant aspect of the magmatic arc system developed in Asian margin during Cretaceous period. In the Upper Cretaceous succession of the Yezo Group, clastic rocks yield abundant detrital chromian spinels with other heavy minerals such as garnet, tourmaline, clinopyroxene, orthopyroxene and hornblende. In these detrital heavy minerals, chromian spinel found in sediments has particular significance to basin analysis because detrital chromian spinel derived from mantle peridotites and primitive rocks is indicative of magmatic and tectonic evolution in the source area. This study aims to clarify the transition of tectonic setting of the Cretaceous magmatic arc on the basis of the chemistry of chromian spinels with other heavy mineral characteristics. Thus, the upper Cretaceous sediments in Teshio-Nakagawa area were selected for this purpose.

The detrital heavy minerals for analysis were prepared by heavy liquid separation. The number of grains analysed by EDS is 97 grains of the chromian spinel, 183 grains of the garnet and 132 grains of the tourmaline. The chemical composition of detrital garnets suggests that the source area was composed of metamorphic rocks reaching greenschist to granulite facies condition and contact metamorphic rocks. Chemical analysis of detrital tourmalines indicates the derivation from metasediment. Chemical composition of the chromian spinel can be classified into three main groups that are (1) low TiO₂ (<0.5wt.%) type, (2) high Cr# (Cr/Cr+Al) - high TiO₂ (>0.5wt.%) type and (3) especially high TiO₂ (>2.5wt.%) type. In particular, this studied have focused on high Cr# and high TiO₂ type, which belong to the most major group of chromian spinels. It is not clear that where these type chromian spinels, implying the sediment supply from primitive volcanic rocks was delivered. In addition, melt inclusions, which were included in some detrital chromian spinels, suggest that their parental magma has basaltic-andesitic affinity. The discovery of chromian spinels with the melt inclusion and high Cr# - high TiO₂ wt.% chromian spinels support existence of primitive volcanic rocks, which had been formed at the onset of the Cretaceous volcanic arc.

Keywords: Cretaceous, Yezo Group, chemical composition, detrital chromian spinel, heavy mineral

多結晶石英と全岩化学組成からみた岐阜県荘川地域に分布する手取層群の後背地 Provenance study of the Tetori Group in the Shokawa area, based on the polycrystalline quartz and whole-rock chemistry

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It is believed that the Jurassic sedimentary rock in Japan was deposited during later stage of the Yangtze and Sino-Korea continental collision. Most of the Jurassic sandstones are characterized by scarceness of rock fragments. The Upper Jurassic sandstones are more quartzose and lack in typical regional metamorphic fragments, however, tectonic environment showing increasing influence from crystalline rocks is obscure. In this study, whole rock geochemistry that obtained by XRF and sedimentary petrology of sandstones in the Middle Jurassic - Lower Cretaceous Tetori Group are discussed.

Sandstones of the Upper Tetori Group contain abundant polycrystalline quartz. Polycrystalline quartz show several varieties from elongated, bimodal, slightly curved, intercrystal boundaries to polygonized. Such polycrystalline quartz was possibly derived from mylonite, ultra mylonite, gneiss and crystalline schist originated from granite and quartzose sedimentary rocks.

The geochemistry of the sandstones in the Upper Tetori Group have less variety in comparison with those in the Lower Tetori Group, which suggests that the Upper Tetori Group was supplied from more monotonous provenance. The Chemical Index of Alteration (CIA : $CIA = Al_2O_3 / (Al_2O_3 + CaO + Na_2O + K_2O)$), which is established as a method of quantifying the degree of source weathering (Nesbitt and Young, 1982, 1984), the Upper Tetori Group exhibits higher CIA values with an enrichment in Zr and REE than those of Lower Tetori Group. Thus the Upper Tetori Group indicates considerable influence by recycled material. Because the late Jurassic major granitic intrusion with uplift are reported in inland area in the eastern part of the Chinese Continent, this transition of provenance implies denudation and exposure of old sedimentary rocks caused by the major uplift of continental crust.

孤立砂丘形態からの風況推定 Estimation of the wind variety using morphology of isolated sand dunes

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Sand dunes change their shaped depending on the wind variety. The shape of sand dunes is often used for an indicator of wind condition in areas where the wind conditions do not be known yet (e.g. extraterrestrial sand dunes on Mars and Titan).

Although sand dunes were used for estimation of long-term averaged wind direction only, a new method for estimating wind conditions was developed based on a series of flume experiments. The method using a phase diagram of isolated sand dunes can indicate bidirectionally-approximated wind variety (i.e. the angular variation and intensity ratio of the bidirectional flows).

In order to confirm the method, the method was applied to some dune field in Western Sahara and Mauritania, because the wind variety in this area was know by previous studies (direct measurement and meteorological reanalysis). The distribution of isolated sand dunes showed bidirectional wind condition consisting of northerly and easterly wind and gradual change of the intensity ratio of bidirectional wind elements. The estimation consisted with the data from the previous s studies.

キーワード: 孤立砂丘, バルハン砂丘, 縦列砂丘

Keywords: isolated dune, barchan dune, longitudinal dune

有機炭素分析による海底地震および洪水起源堆積物の特徴

Terrigenous organic carbon contents of submarine earthquake and flood induced sediments

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深海底では通常半遠洋性の泥が静かに堆積しているが、海底地震や洪水によって発生した混濁流がより粗粒な砂質堆積物をタービダイトとして堆積させることがある。深海底では一度堆積した堆積物が侵食や再移動によって失われる可能性が低いため、このような記録は陸上に残された史料よりも古い過去まで災害記録を保存している可能性がある。堆積物からいつどのような災害が発生したのかを読み取るための情報として、この研究では、近年発生した洪水と海底地震によって海底に形成されたことが明らかな堆積物の特徴を認めることを目的とした。

研究対象は、1989年十津川水害、2003年台風10号、2004年紀伊半島南東沖地震、2011年東北地方太平洋沖地震によって海底に形成された堆積物とそれぞれの海域で通常時に堆積した泥（リファレンス）である。これらの堆積物の有機炭素の安定同位体比を測定し、リファレンスに対して各イベント堆積物の陸源有機炭素の割合がどのくらい増加したかを見積もった。

1989年十津川水害によって紀伊半島沖の新宮海底谷沖の深海底に形成されたタービダイト泥では通常時に堆積した半遠洋性泥よりも陸源の有機炭素が約20-50%増加していた。2003年の台風10号による洪水時に北海道日高地方の沙流川および新冠川河口付近に堆積した堆積物では、有機炭素の約80-95%以上が陸源と見積もられ、リファレンスよりも約40-55%以上多い。また、この洪水によって日高沖海底斜面上部に堆積した泥でも約30%の陸源有機炭素の増加が認められた。

2004年紀伊半島南東沖地震による海底斜面崩壊堆積物では、陸源の有機炭素の割合は約15%と低く、通常時に堆積した半遠洋性泥と比較してこの割合に大きな違いは認められない。2011年東北地方太平洋沖地震後の調査で仙台湾沖および大槌湾沖陸棚から海底斜面にかけて採取された堆積物には、この地震によって形成されたタービダイトが認められている。陸棚に堆積したタービダイト泥では陸源の有機炭素の割合は比較的高いが、地震以前の通常時に堆積していた半遠洋性泥との違いは認められない。また、海底斜面のタービダイト泥は陸棚と比較すると有機炭素の割合が低く、これらも半遠洋性泥と大きな違いは認められない。

洪水起源の堆積物では、河口に近いほど陸源の寄与が大きく、河口から離れ水深が深い陸棚斜面・海盆底の方が陸源の寄与は比較的小さい。一方、海底地震起源のタービダイト泥では、海岸に比較的近く水深の浅い陸棚であっても、より深い海底斜面と同様に陸源の寄与の増加はほとんど認められなかった。

今後は過去のタービダイトの形成要因の解析にこれらの結果を利用したい。

キーワード: 海底堆積物, タービダイト, 洪水, 海底地震, 陸起源有機物, 安定炭素同位体比

Keywords: seafloor sediments, turbidite, flood, submarine earthquake, terrigenous organic matter, stable carbon isotope ratio