

Seminar 1

Session 03: Structure of a scientific paper

Kinoshita Daisuke

Institute of Astronomy, National Central University, Taiwan

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Structure of a scientific paper

- Information on the first page
 - title
 - names of authors
 - addresses of authors' institution
 - abstract
 - keywords

An example

- We take a look at following paper as an example.
 - Astronomy & Astrophysics (Volume 653, September 2021)
 - “Composition of organics on asteroid (101955) Bennu”
 - Kaplan et al., 2021, A&A, 653, L1.
 - <https://doi.org/10.1051/0004-6361/202141167>
- If you use ADS to find the paper, try following.

title:"bennu" author:"^kaplan" bibstem:"a&a"

The screenshot shows a web browser window displaying the NASA/ADS search results for the query "title:'bennu' author:'kaplan' bibstem:'ast'". The browser's address bar shows the URL: <https://ui.adsabs.harvard.edu/search?q=title%3A%22bennu%22+author%3A%22kaplan%22+bibstem%3A%22ast%22&sort=date+desc%2C+bibcode+desc&p=0>. The search results page shows 1 result for the query. The result is a paper titled "Composition of organics on asteroid (101955) Bennu" by Kaplan, H. H.; Simon, A. A.; Hamilton, V. E., and 14 more, published in 2021. The paper is listed as 2021AAS...653L...1K. The page also features a sidebar with navigation options like "AUTHORS", "COLLECTIONS", "REFEREED", "INSTITUTIONS", "KEYWORDS", "PUBLICATIONS", "BIB GROUPS", "SIMBAD OBJECTS", "NED OBJECTS", "DATA", "VIZIER TABLES", and "PUBLICATION TYPE". The main content area includes a "Show Highlights" button, a "Go To Bottom" link, and a "Per Page" dropdown set to 200. The result is displayed as a list item with a checkbox, a date of 2021/09, and a "prev" button.

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Composition of organics on asteroid (101955) Bennu

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Kaplan, H. H. ; Simon, A. A.; Hamilton, V. E.; Thompson, M. S.; Sandford, S. A.; Barucci, M. A.; Cloutis, E. A.; Brucato, J.; Reuter, D. C.; Glavin, D. P.; Clark, B. E.; Dworkin, J. P.; Campins, H.; Emery, J. P.; Fomaski, S.; Zou, X. D.; Lauretta, D. S.

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Introduction
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A&A 653, L1 (2021)
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**Astronomy
Astrophysics**

LETTER TO THE EDITOR

Composition of organics on asteroid (101955) Bennu

H. H. Kaplan¹, A. A. Simon¹, V. E. Hamilton², M. S. Thompson³, S. A. Sandford⁴, M. A. Barucci⁵, E. A. Cloutis⁶, J. Brucato⁷, D. C. Reuter⁸, D. P. Glavin⁹, B. E. Clark¹⁰, J. P. Dworak¹¹, H. Campins⁸, J. P. Emery¹², S. Fornasier¹³, X. D. Zou¹², and D. S. Lauretta¹³

¹ NASA Goddard Space Flight Center, Greenbelt, MD, USA
e-mail: hammah.kaplan@nasa.gov

² Southwest Research Institute, Boulder, CO, USA

³ Department of Earth, Atmospheric, and Planetary Sciences, Purdue University, West Lafayette, IN, USA

⁴ NASA Ames Research Center, Moffett Field, CA, USA

⁵ LESIA, Observatoire de Paris, Université PSL, CNRS, Université de Paris, Sorbonne Université, 5 Place Jules Janssen, 92195 Meudon, France

⁶ Department of Geography, University of Winnipeg, Winnipeg, Canada

⁷ INAF-Arcetri Astrophysical Observatory, Florence, Italy

⁸ Department of Physics, Bhausa College, Bhausa, NY, USA

⁹ Department of Physics, University of Central Florida, Orlando, Florida, USA

¹⁰ Northern Arizona University, Flagstaff, AZ, USA

¹¹ Institut Universitaire de France (IUF), Paris, France

¹² Planetary Science Institute, Tucson, AZ, USA

¹³ Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ, USA

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ABSTRACT

Context. The Origins, Spectral Interpretation, Resource Identification, and Security-Regolith Explorer (OSIRIS-REx) mission detected an infrared absorption at 3.4- μm on near-Earth asteroid (101955) Bennu. This absorption is indicative of carbon species, including organics, on the surface.

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¹ NASA Goddard Space Flight Center, Greenbelt, MD, USA
e-mail: hannah.kaplan@nasa.gov

² Southwest Research Institute, Boulder, CO, USA

³ Department of Earth, Atmospheric, and Planetary Sciences, Purdue University, West Lafayette, IN, USA

⁴ NASA Ames Research Center, Moffett Field, CA, USA

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1. Introduction

The Origins, Spectral Interpretation, Resource Identification, and Security-Regolith Explorer (OSIRIS-REx) mission detected carbon species, including organics and carbonates, on near-Earth asteroid (101955) Benu (Kaplan et al. 2020; Simon et al. 2020a). These findings, based on the presence of an infrared absorption near 3.4 μm , indicate that the sample of Benu's regolith that the OSIRIS-REx spacecraft will return to Earth

total carbon in organic and inorganic forms (Pearson et al. 2006; Alexander et al. 2012; Sephton 2002). The majority of the meteoritic carbon (>70 wt.%) is hosted in insoluble organic matter (IOM): an acid-insoluble kerogen-like macromolecule that is structurally complex, with variable isotopic and elemental compositions (Cody & Alexander 2005; Alexander et al. 2017). The soluble organic matter (SOM) represents a much smaller fraction (up to 0.1%) of the total carbon, with the remainder of carbon either unaccounted for with current techniques

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with those associated with insoluble organic matter in meteorites. Given the thermal and space weathering environments on Bennu, it is likely that the organics have not been exposed for long enough to substantially decrease the H/C and destroy all aliphatic molecules.

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1. Introduction

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Bennu has been spectrally linked to aqueously altered CI- and CM-type carbonaceous chondrites (Clark et al. 2011; Hamilton et al. 2019); these primitive carbon-rich meteorites are likely the closest analogs of Bennu currently available for laboratory studies. CI and CM chondrites contain 1 to 5 wt.%

total carbon in organic and inorganic forms (Pearson et al. 2006; Alexander et al. 2012; Sephton 2002). The majority of the meteoritic carbon (>70 wt.%) is hosted in insoluble organic matter (IOM): an acid-insoluble kerogen-like macromolecule that is structurally complex, with variable isotopic and elemental compositions (Cody & Alexander 2005; Alexander et al. 2017). The soluble organic matter (SOM) represents a much smaller fraction (up to 0.1%) of the total carbon, with the remainder of carbon either unaccounted for with current techniques or contained in inorganic forms (e.g., carbonates and nanodiamonds). Meteoritic SOM can be highly complex, with a variety of different compound classes, such as amino acids, carboxylic acids, hydroxy acids, amines, alcohols, aldehydes, ketones, N-heterocycles, polyols, aliphatic and aromatic hydrocarbons, and sugars (e.g., Glavin et al. 2018).

Most of the meteoritic organic matter likely originated in the interstellar medium or in the colder regions of the protoplanetary disk before being incorporated into the earliest Solar

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Observations and Results parts of a paper

groups have been attributed to nebular processes, thermal and/or aqueous alteration of the parent body (e.g., [Herd et al. 2011](#); [Alexander et al. 2007](#); [Glavin et al. 2010](#)), and surface modification, such as space weathering (e.g., [Thompson et al. 2020](#)).

2. Observations and methods

The OSIRIS-REx Visible and InfraRed Spectrometer (OVIRS; [Reuter et al. 2018](#)) has a circular, 4 mrad field of view. It collected tens of thousands of spectra of Bennu with wavelengths from 0.4 to 4.3 μm . In the wavelength region near 3.4 μm (3.2 to 3.6 μm), there are at least four absorption characteristic of organic carbon, resulting from the symmetric and asymmetric stretching modes of methyl ($-\text{CH}_3$) and methylene ($-\text{CH}_2$) groups (i.e., aliphatic CH; e.g., [Allen & Wickramasinghe 1981](#); [Pendleton 1995](#)).

We analyzed spectra collected during the sample site reconnaissance (Recon A) phase of the OSIRIS-REx mission in October 2019 ([Lauretta et al. 2021, 2017](#)). The Recon A data set in this study comprises 15 585 photometrically corrected OVIRS spectra that cover 10% of the surface; it focuses on regions of interest, including the Nightingale site (Hokioi crater), where OSIRIS-REx collected its sample (see [Appendix A](#) for more observation details and coverage map). We used these data, rather than the global-coverage data set at 20 m per footprint ([Simon et al. 2020a](#)), because the spatial resolution (4–5 m cross-track and 7–10 m along-track) is optimized to isolate

at 3.42 μm has been linked to the composition and concentration of organic matter in sedimentary rocks and meteorites (e.g., [Herron et al. 2014](#); [Kaplan & Milliken 2018](#)). For IOM extracted from carbonaceous chondrites, band depth is positively correlated with the hydrogen-to-carbon ratio (H/C; [Kaplan et al. 2019](#)). If there is not enough hydrogen in the organics (i.e., $\text{H/C} < 0.3$), there will be no absorption at 3.42 μm . For IOM in bulk rock (i.e., meteorites), the absolute concentration is also important: $>1 \text{ wt.}\% \text{ C}$ is needed to observe an absorption at 3.42 μm ([Kaplan et al. 2019](#)). Most CMs and CIs contain 1–3 wt.% C and have bulk H/C ratios in the IOM > 0.5 ([Alexander et al. 2007](#)).

3. Results

3.1. Spectral features

Most OVIRS spectra appear to be a mixture of organic and carbonate material, which is not suitable for our analysis. In total, only 237 of the 15 585 spectra analyzed are well fit by the organic laboratory spectra described in [Sect. 2](#) ($\chi^2 < 2$; see [Appendix A](#)). We refer to these hereafter as organic-rich spectra because they have absorption band positions and widths that match laboratory organic spectra ([Fig. 1](#)). These organic-rich spectra are distributed across the asteroid surface (i.e., are not concentrated in any given region), suggesting a wide spatial distribution of organics ([Ferrone et al. 2021](#)). The spectral features themselves are not homogenous and have varying absorp-

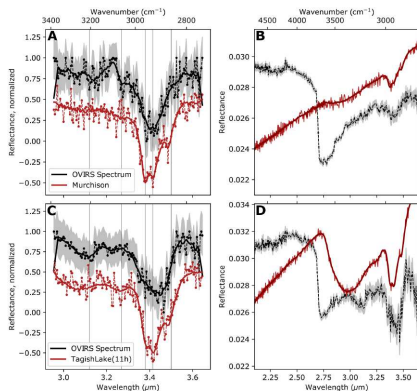


Fig. 2. Laboratory spectral matches for organic spectral shapes observed on Benu. The most common spectral shapes in the Benu spectra that we analyzed are well matched with spectra of meteorite IOM. (a) and (c) Best fits in the 3.1 to 3.6 μm region between the OVIRS spectra (black) and the IOM spectra (red, solid), with noised added to simulate OVIRS noise (red, dashed); the spectra are normalized from 0 to 1 and

4. Discussion

The spectral features from 2.9 to 3.6 μm observed on Benu allow us to compare this asteroid to other extraterrestrial settings. The OVIRS data are comparable to the spectra seen in the diffuse interstellar medium (Allen & Wickramasinghe 1981; Sandford et al. 1991), comet 67P (Raponi et al. 2020), and multiple large main-belt asteroids (Simon et al. 2020a). We find that carbonaceous chondrite IOM is the closest laboratory analog to Benu's organics based on the available spectral data at the wavelengths covered by the OVIRS instrument. This finding strengthens the previously described connection between Benu and carbonaceous chondrite meteorites (Clark et al. 2011; Hamilton et al. 2019, 2021). The macroscale heterogeneity of the organic-rich spectra of Benu has not been observed elsewhere in the Solar System (potentially owing to a lack of spacecraft data in most cases) but is mirrored in the large heterogeneity seen at small scales in meteorite organics (e.g., Alexander et al. 2017).

The organics on Benu may reflect heterogeneous aqueous alteration conditions. Although aqueous alteration has been reported to decrease H/C (Herd et al. 2011), the modification of organics is primarily controlled by heating (Alexander et al. 2014; Quirico et al. 2018), and the variation in H/C and C wt.% estimated for organic-rich OVIRS spectra may be the result of variable heating (Fig. 3). Typically, higher H/C values are also associated with higher N/C, O/C, and bulk C (Alexander et al. 2007). Though spectra with a feature near 3.1 μm may indicate

2021). Thus, the space weathering of organics may result in competitive spectral trends, depending on the dominant constituent processes, initial composition, and/or the timescales of surface exposure.

The potential for the rapid breakdown of aliphatic organics would indicate that where these compounds are observed on Bennu, the surface has been exposed for a relatively short period of time. Spectrophotometric studies suggest that Bennu's small craters may be less than tens of thousands of years old (DellaGiustina et al. 2020). In addition, evidence of particle ejection and re-impact (Lauretta et al. 2019) and thermally driven fracturing (Molaro et al. 2020) on Bennu indicates that ongoing surface processes are continually exposing fresh material at the surface.

5. Conclusions

The detection of organic matter on asteroid Bennu using the OVIRS instrument on board the OSIRIS-REx spacecraft provides a preview of the composition of the sample that will be returned to Earth in 2023. Spectral features near 3.4 μm , including a strong absorption minimum between 3.38 and 3.42 μm and a possible shoulder at 3.3 μm , are indicative of aliphatic and aromatic CH with a maximum H/C of 0.6 and a minimum H/C of 0.3. The overall spectral shape in the OVIRS data is most comparable to meteorite IOM, as opposed to other organic

soluble organic diversity and composition.

Acknowledgements. We are grateful to the entire OSIRIS-REx Team for making the encounter with Bennu possible. This material is based upon work supported by NASA under Contract NNM10AA11C issued through the New Frontiers Program. OVIRS spectral data from Recon A are available via the Planetary Data System at <https://sbn.psi.edu/pds/resource/orex/ovirs.html> (Reuter et al. 2019). Data are delivered to the PDS according to the schedule in the OSIRIS-REx Data Management Plan, available in the OSIRIS-REx mission bundle at <https://sbnarchive.psi.edu/pds4/orex/orex.mission/document/>.

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Figure in a paper

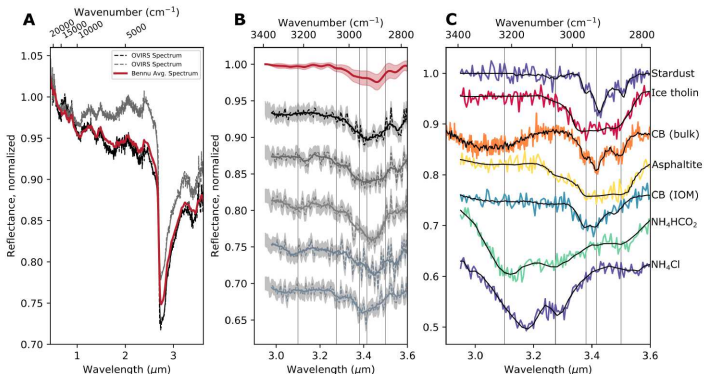


Fig. 1. Evidence of organics on Benu in spectral features near 3.4 μm. (a) Average OVIRS spectrum of Benu (red) and two OVIRS spectra of Benu with spectral features near 3.4 μm. (b) Close-up of the continuum-removed region around 3.4 μm, offset, with wavelengths of C-H absorptions indicated by vertical gray lines. The top three spectra are the same as those shown in panel a. The shaded region indicates uncertainties, and the vertical lines at 3.10, 3.275, 3.38, 3.42, and 3.50 μm indicate positions of possible absorption features. (c) Laboratory spectra near 3.4 μm for comparison. Black lines are the spectra, and colors are spectra with noise added to simulate OVIRS noise. “CB” stands for “Cold Bokkeveld”, “bulk” refers to the whole meteorite, and “IOM” refers to the extracted insoluble organic component.

Table 3. Molecular surface density at 250 au derived with DiskFit.

Molecules		Surface density (cm^{-2})	Molecules		Surface density (cm^{-2})
^{13}CO	D	1.10×10^{16} ^(*)	CS	D	$(2.6 \pm 0.03) \times 10^{13}$
C^{18}O	D	2.42×10^{15} ^(*)	^{13}CS	D	$(2.6 \pm 0.7) \times 10^{11}$
$^{13}\text{C}^{17}\text{O}$	U	$<1.2 \times 10^{13}$	CCS	D	$(1.5 \pm 0.2) \times 10^{12}$
CN	D	$(7.7 \pm 0.1) \times 10^{13}$	OCS	M	$(4.5 \pm 2.3) \times 10^{10}$
^{13}CN	D	$(2.8 \pm 1.1) \times 10^{12}$	<i>p/o</i> -H ₂ CS	U	$<8.2 \times 10^{13}/5.3 \times 10^{12}$
CCH	D	$(6.8 \pm 0.1) \times 10^{13}$	SO	U	$<4.5 \times 10^{12}$
N_2H^+	D	$(1.2 \pm 0.1) \times 10^{12}$	SO ₂	U	$<5.0 \times 10^{12}$
N_2D^+	U	$<1.3 \times 10^{11}$	SiO	U	$<4.5 \times 10^{11}$
HCN	D	$(6.70 \pm 0.04) \times 10^{12}$	DCN	M	$(1.9 \pm 1.2) \times 10^{11}$
H^{13}CN	U	$<1.6 \times 10^{11}$	CCD	U	$<1.0 \times 10^{14}$
HC^{15}N	U	$<2.9 \times 10^{11}$	HDO	U	$<1.9 \times 10^{10}$
HNC	D	$(3.4 \pm 0.03) \times 10^{12}$	DNC	D	$(2.7 \pm 0.7) \times 10^{11}$
HN^{13}C	U	$<1.7 \times 10^{11}$	D ₂ CO	U	$<1.6 \times 10^{10}$
HCO ⁺	D	$(1.50 \pm 0.01) \times 10^{13}$	DCO ⁺	M	$(2.2 \pm 0.7) \times 10^{11}$
H^{13}CO^+	D	$(4.0 \pm 0.2) \times 10^{11}$	<i>p</i> -H ₂ CO	D	$(3.6 \pm 0.2) \times 10^{12}$
HOC ⁺	U	$<3.2 \times 10^{10}$	<i>c</i> -C ₃ H ₂	U	$<1.0 \times 10^{12}$
HCNH ⁺	U	$<2.2 \times 10^{13}$	HC ₃ N	D	$(5.4 \pm 1.1) \times 10^{11}$
HCCCHO	U	$<1.4 \times 10^{17}$	CH ₃ CN	U	$<2.5 \times 10^{11}$
C^{34}S	D	$(1.0 \pm 0.1) \times 10^{12}$			

Notes. The temperature uncertainty only affects the derived densities by factors smaller than 2. D = detected, U = undetected, and M = marginal detected $T_0 = 15$ K for S-bearing species, and $T_0 = 25$ K for all other molecules. ^(*)The values are taken from [Phuon et al. \(2020\)](#).

Table 4. Molecular abundance with respect to ^{13}CO : $10^5 \times (X_{\text{mol}}/X_{^{13}\text{CO}})$.

Mol.	TMC-1	LkCa 15	GG Tau	Mol.	TMC-1	LkCa 15	GG Tau
C^{18}O	1.1×10^4 ⁽¹⁾	2.8×10^4 ⁽⁷⁾	2.2×10^4	C^{34}S}	...	...	10 ± 1
CN	2250 ⁽¹¹⁾	3100 ⁽⁸⁾	660 ± 30	CS	1500 ⁽³⁾	520 ⁽⁸⁾	230 ± 10
^{13}CN}	...	...	25 ± 10	^{13}CS	11 ⁽⁴⁾	2.8 ⁽¹⁰⁾	2.2 ± 0.6
CCH	5960 ⁽²⁾	1200 ⁽⁸⁾	600 ± 30	CCS	240 ⁽³⁾	...	13 ± 2
N_2H^+	7680 ⁽¹¹⁾	19.1 ⁽⁹⁾	10.5 ± 0.5	OCS	1500 ⁽¹⁾	...	0.4 ± 0.2
HCN	1500 ⁽²⁾	300 ⁽⁸⁾	57 ± 3	DCN	22 ⁽⁶⁾	7.5 ⁽⁹⁾	1.6 ± 1.0
HNC	1500 ⁽²⁾	...	29 ± 2	DNC	124 ⁽⁶⁾	3.5 ⁽⁹⁾	2.3 ± 1.1
HCO ⁺	596 ⁽²⁾	350 ⁽⁸⁾	125 ± 5	DCO ⁺	30 ⁽⁵⁾	4.5 ⁽¹¹⁾	3.5 ± 0.2 ⁽¹³⁾
H^{13}CO^+	8.3 ⁽¹⁾	5.0 ⁽¹²⁾	3.4 ± 0.2				
H ₂ CO	1500 ⁽²⁾	13.6 ⁽⁹⁾	33 ± 2 ^(*)	HC ₃ N	473 ⁽²⁾	7.3 ⁽¹²⁾	4.6 ± 0.9

Notes. ^(*)For para-H₂CO only in GG Tau. Since estimating the uncertainties from all of these different studies was very difficult, we do not quote them for TMC1 and LkCa15.

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4. Discussion

4.1. Sulphur in protoplanetary disk: First detection of CCS

Beyond CS, only a few S-bearing species observed in molecular

Acknowledgements

Acknowledgements. We are grateful to the entire OSIRIS-REx Team for making the encounter with Bennu possible. This material is based upon work supported by NASA under Contract NNM10AA11C issued through the New Frontiers Program. OVIRS spectral data from Recon A are available via the Planetary Data System at <https://sbn.psi.edu/pds/resource/orex/ovirs.html> (Reuter et al. 2019). Data are delivered to the PDS according to the schedule in the OSIRIS-REx Data Management Plan, available in the OSIRIS-REx mission bundle at <https://sbnarchive.psi.edu/pds4/orex/orex.mission/document/>.

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Outline

Abstract

1. Introduction
2. Samples and methods
3. Results
4. Discussion
5. Summary and conclusions

Acknowledgments

Appendix A. Supplementary data

References

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Figures (15)

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Tables (3)

- Table 1
- Table 2
- Table 3

Geochimica et Cosmochimica Acta
Volume 71, Issue 17, 1 September 2007, Pages 4389–4403

The origin and evolution of chondrites recorded in the elemental and isotopic compositions of their macromolecular organic matter

C.M.O'D. Alexander^a, A.M.M. Feggel^b, H. Yabuta^b, G.D. Cody^b

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Abstract

Extraterrestrial organic matter in meteorites potentially retains a unique record of synthesis and chemical/thermal modification by parent body, nebular and even presolar processes. In a survey of the elemental and isotopic compositions of insoluble organic matter (IOM) from 75 carbonaceous, ordinary and enstatite chondrites, we find dramatic variations within and between chondrite classes. There is no evidence that these variations correlate with the time and/or location of chondrite formation, or with any primary petrologic or bulk compositional features that are associated with nebular processes (e.g., chondrule and volatile trace element abundances). Nor is there evidence for the formation of the IOM by Fischer-Tropsch-Type synthesis in the nebula or in the parent bodies. The elemental variations are consistent with thermal maturation and/or oxidation of a common precursor. For reasons that are unclear, there are large variations in isotopic

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Appendix A: Supplementary material

A.1. Additional information on the data set

We used OVIRS spectra from the Recon A phase of the OSIRIS-REx mission, specifically those that were collected on four separate dates in October 2019 (Reuter et al. 2019). These observations covered the mission's primary sample collection site, Nightingale, and three other candidate sample sites (Lauretta et al. 2021), as well as a few other areas of interest that were observed by opportunity. The spacecraft scanned the surface from a 1 km range with varying phase angles; the scan patterns are shown in Fig. A.1. OVIRS data collected during Recon A have a spatial resolution of 4 to 5 m cross-track and 7 to 10 m along-track (36 m^2).

A.2. Methods: Calibration and data processing

Full details of the calibration pipeline are described in Simon et al. (2018). Briefly, each OVIRS spectrum comprises five segments collected from separate linear variable filters, with overlapping wavelengths that are resampled to create a continuous spectrum from 0.39 to $4.3 \mu\text{m}$ (Reuter et al. 2018). A thermal tail is subtracted from calibrated radiance (resampled) spectra, and the result is divided by solar flux to obtain reflectance (I/F ; Simon et al. 2020a). Thermal fill-in can occur

for the sake of direct comparison (Tables A.2 and A.3). These spectra are all previously published, and references can be found in the main text. To compare spectral shape rather than feature strength, we normalized each continuum-removed spectrum to have a maximum value of 1 and a minimum value of 0 (Fig. 2). All analyses were performed on unsmoothed spacecraft data and reflect the noise inherent in spacecraft data; Figs. 1 and 2 also show spectra smoothed to demonstrate the likely underlying shape.

We used two previously tested methods to separate organic (CH) absorptions near $3.4 \mu\text{m}$ from the carbonate (CO_3) absorptions that are found at similar wavelengths to obtain the organic-rich group of spectra (Kaplan et al. 2020; Ferrone et al. 2021); both methods resulted in similar rates of organic and carbonate identification for the Recon A data set (Ferrone et al. 2021). The first method is linear least-squares fitting, in which we compared (unsmoothed) OVIRS spectra and laboratory spectra (at their native S/N but resampled to OVIRS spectral resolution) on a channel-by-channel basis from 2.9 to $3.6 \mu\text{m}$ to find the laboratory spectrum that best fits the shape of the organic features observed in our Recon A data set. We assessed the goodness of fit with a χ^2 statistic (Kaplan et al. 2020, Fig. A.4). Recon A spectra that were fit by one of the organic laboratory spectra with a χ^2 value < 2 were designated as organic-rich for this study, which resulted in 237 used for further analyses (e.g., in Fig. 3). The full

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Editorial

Introducing structured abstracts for A&A articles*

Claude Bernou¹ and Peter Schneider²

¹ Editor-in-Chief, Astronomy & Astrophysics, Observatoire de Paris, 61 Avenue de l’Observatoire, 75014 Paris, France
² Leites Editor, Astronomy & Astrophysics, Institut für Astrophysik und extraterrestrische Forschung der Universität Bonn, Auf dem Hügel 71, 53121 Bonn, Germany

ABSTRACT

Context. Due to their wide availability, abstracts have become the most important part of any astrophysical paper.
Aims. Having noticed that abstracts published in astronomical journals are not always optimal, we introduce the concept of structured abstracts for A&A articles.
Methods. We explain what structured abstracts are and where they come from, provide examples showing how to structure an abstract, and discuss the advantages and drawbacks of this novel concept. In an on-line appendix, we show what some published abstracts look like once they are structured.
Results. We demonstrate the improvements in information content, readability, and style that can be made when writing structured abstracts instead of traditional ones.
Conclusions. A new version 6.0 of the A&A LaTeX macro is now available for structuring the abstracts of articles, and A&A authors are kindly invited to use it for their new submissions.

Key words. Editorials

1. Introduction

Confronted with a huge volume of new information every week, researchers in the physical sciences can no longer read all the literature that is published on scientific matters that interest them. The paper’s abstract, undoubtedly the most visible part of any scientific article, has therefore in recent years become particularly important as a *filter* for deciding what articles are worth taking the time to read in detail. This is particularly true for astrophysics articles, since the abstract is referenced and widely accessible in the NASA Astrophysics Data Service, in topical newsletters, and in other abstract databases.

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Introduction (1)

Confronted with a huge volume of new information every week, researchers in the physical sciences can no longer read all the literature that is published on scientific matters that interest them. The paper's abstract, undoubtedly the most visible part of any scientific article, has therefore in recent years become particularly important as a filter for deciding what articles are worth taking the time to read in detail. This is particularly true for astrophysics articles, since the abstract is referenced and widely accessible in the NASA Astrophysics Data Service, in topical newsletters, and in other abstract databases.

Introduction (2)

Whether a colleague will read your paper or not thus depends in large measure on the level of interest that is gained from reading your paper's abstract. When writing it, one must therefore make sure that it conveys the essential elements of the article to the reader: its objective, the methods used to reach it, and the results obtained. This must be done in a concise yet informative way, without using external references that will not be referenced in the abstract databases. Finally, the style must be pleasing.

Introduction (3)

While editing A&A articles, we have become aware that the abstracts of published papers have not always fulfilled the criteria given above. Sometimes an abstract will be so concise and specialized that only the few people working in the paper's specific research field are able to understand the significance of results obtained by the author. At other times, the abstract goes into unnecessary detail and becomes much too unwieldy. We have also seen cases where the abstract does not reflect the paper's contents, either because some important results are not mentioned or because results presented in the abstract are not substantiated in the text of the paper. Of course, these extreme cases remain relatively rare, but we nonetheless concluded from studying a large number of A&A abstracts that in most cases, they could be written in a clearer and more informative way.

Introduction (4)

This is why we are introducing the concept of structured abstracts for A&A papers. The following will hopefully be able to convince you that the information content, readability, and style of your abstracts will be vastly improved by adopting the simple rules of structured abstracts, thereby increasing the impact of your articles.

What are structured abstracts? (1)

As with a traditional abstract, a structured abstract summarizes the contents of the paper, but it also makes the structure of the article explicit and visible. To accomplish this, the structured abstract uses headings that define each of several short paragraphs and that reflect the particular needs of the discipline. For astronomy papers, we propose to use three mandatory paragraphs as the core of the structured abstract, entitled, respectively, Aims, Methods, and Results. When appropriate, the structured abstract may use an introductory paragraph entitled Context, and a final paragraph entitled Conclusions. While these headings are self-explanatory, one should emphasize that there is no redundancy between them. For example, the Aims paragraph describes the objectives of the paper, while Context explains the reasons for the current investigation and may give background. Similarly, Results summarizes the results found in the paper, while Conclusions explains the significance of the results in a more general framework.

What are structured abstracts? (2)

Although structured abstracts are now mandatory in most medical research journals and are also successfully used in the social sciences, they have so far attracted little attention in the physical sciences. We note, however, that the astronomical community already uses structured documents, such as the well-known ESO Observing Proposal. Many other observing and grant proposal formats make use of structured contents, so the principle is not new to astronomers.

Structured abstract

- Context
 - reasons for the current investigation
 - background
- Aims
 - objectives
- Methods
- Results
- Conclusions
 - significance of the results

Today's Exercise #2

- Go to Astrophysical Journal website.
 - <https://iopscience.iop.org/journal/0004-637X>
- Visit the Volume 936 of ApJ.
 - <https://iopscience.iop.org/volume/0004-637X/936>
- Visit the Issue Number 1 (1 September 2022).
 - <https://iopscience.iop.org/issue/0004-637X/936/1>
- Pick a paper.
- Read the abstract of the paper you have picked.
- Analyse the abstract.
 - What is the context of the paper?
 - What is the aims of the paper?
 - What is the methods of the paper?
 - What is the results of the paper?
 - What is the conclusions of the paper?
- Tell us the results of your analysis.
- Tell me if you have any difficulty for doing this exercise.
- When finished, tell me so.

Today's Exercises #1 and #2

- Visit the Google Forms and submit the material.
 - Make a single PDF file and write down your answers for both Exercise #1 and #2.
 - Submit your results by 10:00 on 28/Sep/2022.
 - Link to Google Form:
https://s3b.astro.ncu.edu.tw/seminar1_202209/