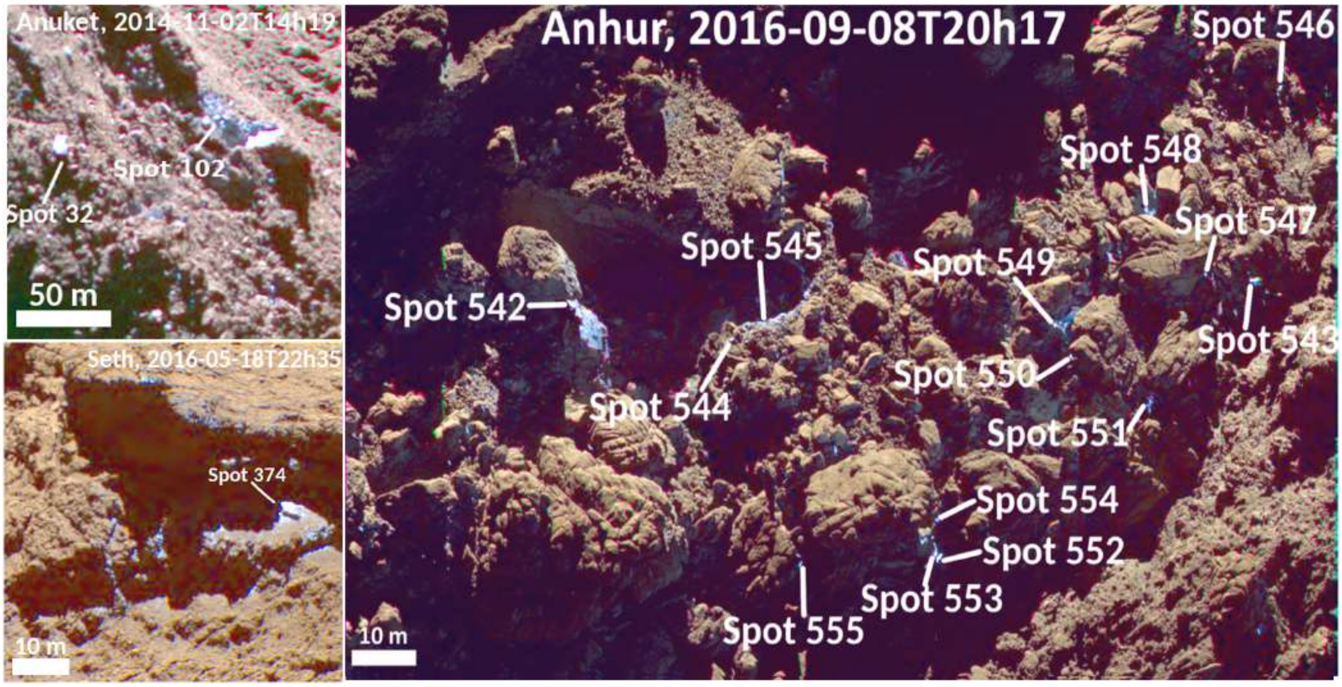

Fig. 3. Example of bright features resting on boulders (BS 32 in Anuket, BS 374 in Seth, and BS 542 and BS 544 in Anhur), type 3 following Deshapriya et al. (2018) classification scheme. The bright spot numbers correspond to those listed in Table A.1. Several BS show blue colors, indicating a small or negative spectral slope value (see Table A.1).

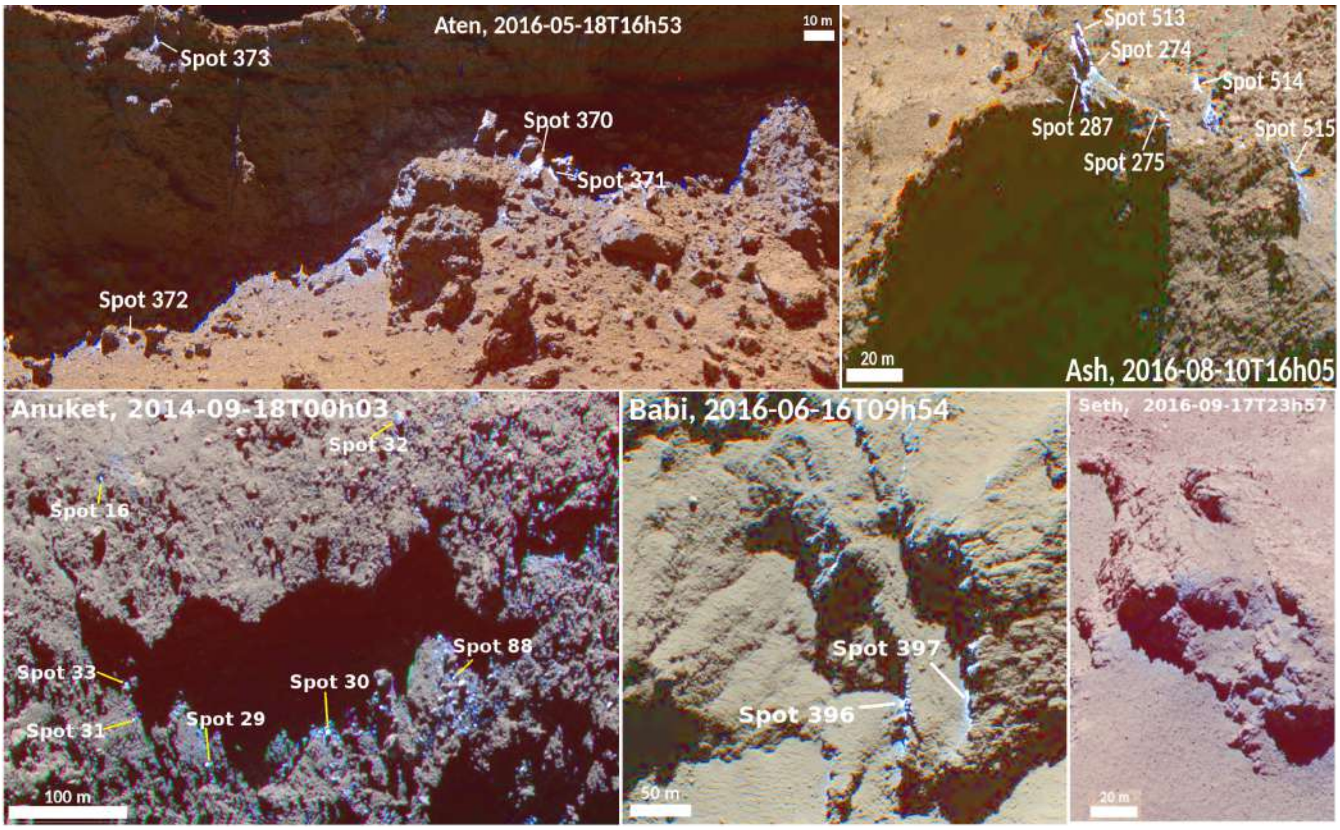

Fig. 4. Example of clusters of bright spots, type 4 following the Deshapriya et al. (2018) classification scheme. The bright spot numbers correspond to those listed in Table A.1. Several BS show blue colors, indicating a small or negative spectral slope value (see Table A.1).

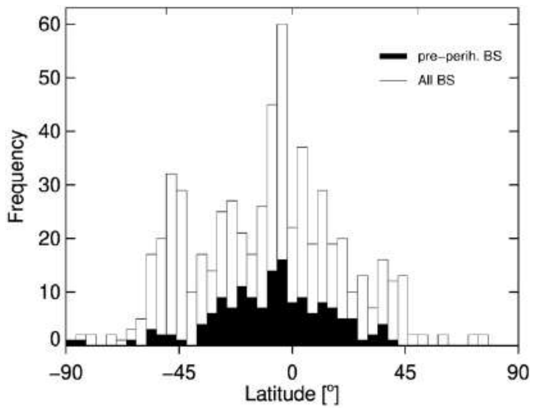

Fig. 5. Frequency of the bright spots vs. latitude. The histogram in black represents the pre-perihelion BS.

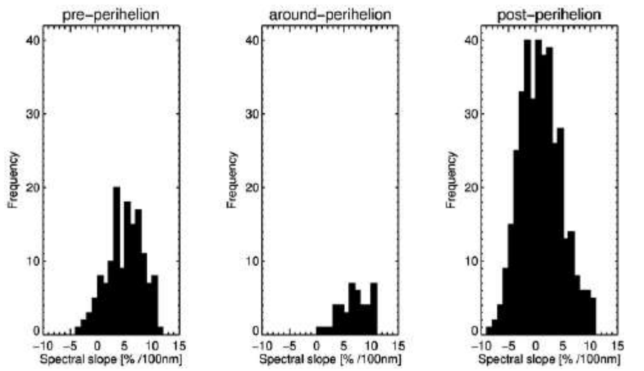

Fig. 6. Histograms showing the bright spot spectral slopes, evaluated in the 535–882 nm wavelength range, pre-perihelion (August 2014–May 2015), during perihelion (June–October 2015), and post-perihelion (November 2015–September 2016).

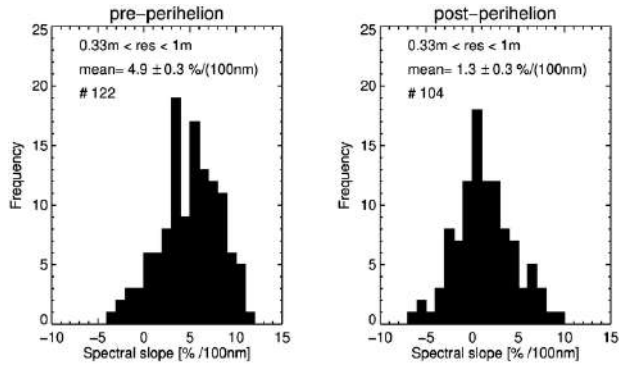

Fig. 7. Histograms showing the bright spots spectral slopes, evaluated in the 535–882 nm wavelength range, in images having similar high resolution (in the 0.33–1 m px^{-1} range), in the pre-perihelion (August 2014–May 2015), and post-perihelion (November 2015–September 2016) periods.

of them are long-lived features; for example, the blue enriched areas in the Seth alcove (bottom right part of Fig. 4) was observable for more than two years. Tiny spots (i.e., under 1 m^2) were frequently identified inside the Hatmehit rim in high-resolution post-perihelion images (Hoang et al. 2020), but mostly with a duration of a few minutes or 1 day, indicating the presence of frost, with the notable exception of a few BS that survived for 6–8 days.

Volatile exposures are found at different latitudes post-perihelion. During the pre-perihelion observations they are more concentrated in the equator and mid-latitudes, between –40° and 40° (Fig. 5).

5. Spectral slope distribution of the bright spots

We investigated the spectral slope distribution, evaluated in the 535–882 nm range, of the BS during the different comet orbital periods (Fig. 6), which we defined as follows: pre-perihelion from August 2014 to the end of May 2015; during perihelion from June to October 2015; post-perihelion from November 2015 to the end of the Rosetta mission on 30 September 2016.

The volatile exposures show a distinct spectral slope distribution in the post-perihelion period, with the presence of several bright spots having negative spectral slope values, while pre-perihelion and during perihelion the BS spectral slope values were close to zero or moderately positive, with very few BS showing negative values (Fig. 6). It should be noted that the observations at perihelion were acquired at relatively high distances and low spatial resolution (3–10 m px^{-1}), preventing the identification of square-meter-sized bright spots. The observing conditions explain the limited number of bright spots observed close to perihelion. The average spectral slope values in the 535–882 nm range of pre-perihelion, perihelion, and post-perihelion bright spots are 5.0±0.3 %/(100 nm), 6.8±0.4%/(100 nm), and 0.9±0.2%/(100 nm), respectively. To exclude that the lower spectral slope values of the BS in the post-perihelion images are related to spatial resolution effects, we investigated the BS spectral slope distribution for pre- and post-perihelion data acquired at similar high resolution, between 0.33 m px^{-1} (the highest pre-perihelion resolution available) and 1 m px^{-1}. The histograms shown in Fig. 7 confirm the trend observed in Fig. 6, and thus the decrease in the BS spectral slope in post-perihelion images. The average spectral slope values of the BS investigated at similar high resolution is of 4.9±0.3%/(100 nm) for the pre-perihelion BS, and 1.3±0.3%/(100 nm) for the post-perihelion BS.

Moreover, we found that 57 spots have unusually negative slope values (i.e., below –3%/(100 nm)) in the 535–882 nm range, which we call blue spots. All except one were observed after perihelion. The only pre-perihelion one was detected on 5 September 2014 in Imhotep (BS 42 in Table A.1). This region also hosts the first blue sloped post-perihelion BS, which was detected at the end of November 2015 (BS 205 in Table A.1). In the same period a blue sloped BS was also observed in Anuket (BS 199).

Twenty-two of these blue spots were observed in the Anhur region (a few examples are shown in Fig. 8), close to the canyon structure (see Fornasier et al. 2017 for the Anhur morphological description) that also hosted one of the brightest outbursts reported for comet 67P during the Rosetta observations, called the perihelion outburst, which took place on 12 August 2015 (Fornasier et al. 2019a). Another region showing blue spots (a total of 13) is Khonsu. These features are located in the low bank area (i.e., a flat area between –20° and –30° latitude) defined and investigated by Hasselmann et al. (2019), where they report important morphological changes. This area was also the source of several activity events during the perihelion passage, including an outburst on 14 September 2015 (Vincent et al. 2016; Hasselmann et al. 2019).

The presence of blue spots is not restricted to the big lobe or to the southern hemisphere of the comet (where Anhur and