

**SPECTROSCOPIC ANALYSIS OF GEMINID METEORS.**

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**Introduction:** The Geminid meteor shower is one of the most intense annual meteor showers. The parent body of the shower is asteroid (3200) Phaethon. The orbit of the shower and its parent body is notable by the short period (~1.5 yr) and small perihelion distance (0.14 AU). Since the Phaethon discovery in 1983, the question has arisen, whether it is a regular asteroid or dormant comet. Detailed observations have shown no sign of cometary activity of Phaethon [1]. The activity profile of the shower suggests an age of the meteoroid stream of several thousands years. The stream was possibly formed within one orbital revolution of Phaethon around Sun [2]. Geminids produce no meteorites because of their large entry speed (36 km/s), nevertheless, their strength and density was found to be closer to stony meteorites than cometary meteoroids [3]. On the other hand, our recent work on sporadic meteors [4] has shown that solar heating at small perihelion distances leads to the loss of volatile sodium and to general compaction of meteoroids. In this paper we study the chemical composition of Geminids from video and photographic spectroscopy.

**Results:** We analyzed 79 video spectra and 2 photographic spectra of Geminid meteors. The Mg/Fe ratio was found to be 1.5–3 times larger than the chondritic value. Similar values were earlier found for cometary showers Leonids and Perseids [5]. The Na abundance in Geminids is generally low but shows large variations from meteor to meteor. The Na/Mg ratio is always lower than chondritic. The Na/Fe ratio varies from chondritic to 10 times lower than chondritic. There is a weak trend of increasing Na abundance with increasing meteoroid mass; nevertheless, the spread of values is large for each mass interval within the range of  $10^{-6}$  to  $3 \times 10^{-4}$  kg. There is a hint that the average Na abundance is lower in the outlying parts of the shower, several days before maximum.

**Discussion:** The high Mg/Fe ratio suggests cometary origin of Geminids. The depletion of Na was evidently caused by thermal desorption in the vicinity of Sun. The large variations in Na abundance need, nevertheless, an explanation. One possibility is that the meteoroids are of different ages, i.e. that they were released from the parent body at different times. Younger meteoroids suffered less Na loss because they were shielded inside the parent body before their ejection. This scenario would imply that Phaethon was an active comet over a long period of time. Alternatively, if the period of activity was short, different depths of meteoroid material inside the parent body could perhaps explain the differences in the Na content. The study of Quadrantid meteors showed that partial Na loss can occur also on the surface of the parent body [6].

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