PHYSICAL AND MECHANICAL PROPERTIES OF SAYH AL UHAYMIR 001 AND GHUBARA METEORITES. E.N. Slyuta[1], S.M. Nikitin[1], A.V. Korochantsev[1], C.A. Lorents[1], [1]Vernadsky Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, Moscow, Russia. slyuta@mail.ru.

Introduction: As against of the data on chemical, mineralogical and isotopic composition of meteorites the physical and mechanical properties of ones of different classes and types are very poorly investigated. But without knowledge of meteorite-analogue strength properties the age of an asteroid by the data on a saturation of impact craters sometimes even approximately does not yield to estimation [1], or the minimal and maximal value may differ by two (!) orders of magnitude [2]. It is also a problem of meteoroid breakup height in the Earth upper atmosphere and an estimation of a meteorite shower area [3]. It is a problem of tidal asteroid destruction within the Earth gravitation field and an adequate estimation of asteroidal hazard [4]. There is a problem of creation of reliable engineering models of space objects for their research with spacecrafts. Finally, parameters of transition between the small and the planetary Solar system bodies are determined also by mechanical and rheological properties of material [5, 6]. But unfortunately, strength and rheological properties of material practically do not yield gracefully to theoretical investigations and their almost unique source is the experimental and observed data.

Sayh al Uhaymir 001 and Ghubara meteorites: Sayh al Uhaymir 001 (SAUH 001) is a stony meteorite shower found March 16, 2000 and is one of Oman's largest known meteorite showers [3]. More than 2670 samples weighing more than 450 kg have been collected. On composition the meteorite is ordinary chondrite of L4/5 petrographic type (Fayalite - 24.7 mol%; Ferrosilite - 21.4 mol%) with S2 shock stage. Very important, that this is recent enough falling poorly altered by terrestrial weathering (W1). Ghubara meteorite is ordinary chondrite of L5 petrographic type. The meteorite has been found in 1954 in Oman on the surface of the desert. The stones are fresh infernally and the crust only slightly weathered.

Technique: Physical and mechanical properties of meteorites were investigated by a standard technique according to working instruction on research of rocks and ores at carrying out of geological engineering survey [7, 8]. The sample of SAUH 001 meteorite of approximately 9×10×12 cm in size has been cut on three plates which are perpendicular each other, everyone by thickness of 2 cm, and on one cube of 4×4×4 cm in size with the sides parallel to all three plates (Fig. 1). Such technique allows investigating volumetric anisotropy of physical and mechanical properties in a sample. The smaller sample of Ghubara meteorite has been cut only on two plates of approximately 2.2×3.7×6.2 cm in size, and on one cube of 2×2×2 cm in size (Fig. 2). The techniques of measurements have been described shortly at [9]. Compressive and tensile strength was measured on air-dry samples by CD-100 and CD-10 testing machines (VEB Werkstoffpruffmaschnen, Leipzig, Germany) which allow to carry out proportional loading in a range of up to 100 and 10 tonnes accordingly. The splitting method was applied to measure of tensile strength with measurement of the enclosed load and destroying effort [7]. Each plate depending on its sizes has been broken onto samples of the semi regular shape approximately of (20-30)×(20-30)×(20-30) mm in size. Compressive strength was measured with compressing of the cubes and the samples of semi regular cubic shape received during splitting of plates after tensile strength measurements (Table 1). Compressive strength of the cube of SAUH 001 meteorite is 112.44 MPa (Fig. 3). Young modulus and Poisson coefficient was calculated with equations for uniaxial load at registration of longitudinal and cross deformations in two directions (Table 1).

Fig. 1. The cutting plan of SAUH 001 meteorite.

Fig. 2. The cutting plan of Ghubara meteorite.

Results: Volumetric distribution of compressive strength in a sample of SAUH 001 meteorite is not isotropic (Table 2). One direction differs on 30% from other two on which it is observed practically isotropic distribution of compressive strength. Variation coefficient than 30% there are less, and on the main direct it is less by a factor of two, that specifies significant distinction. Volumetric distribution of compressive strength may be represented as a prolate ellipsoid. Speed of P-waves correlates also with compressive strength value (Table 2). Volumetric distribution of tensile strength is practically isotropic and may be represented as a sphere. It is obvious, that volumetric distribution of

Table 1. Physical and mechanical properties of meteorites

Name	SAUH 001			Ghubara		
	Average value	Number of measurements	Variation coef., %	Average value	Number of measurements	Variation coef., %
Dencity, g cm^{-3}	3.40	4	0.97	3.45	3	-
Compressive strength, Mpa	97.50	23	27.70	72.22	5	30.69
Tensile strength, Mpa	16.36	23	33.28	23.55	5	30.51
Young modulus, 10^{-5} MPa	0.171	-	12.10	-	-	-
Poisson coefficient	0.33	39	21.20	-	-	-
P-wave, m c^{-1}	3165.33	320	15.55	2989.9	21	21.19

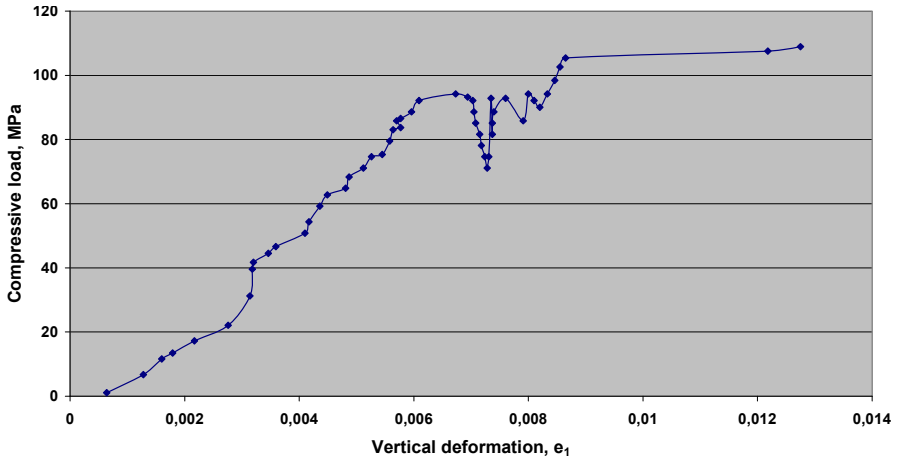

Fig. 3. The deformation-loading characteristic of compression of the cubic sample of SAUH 001.

compressive strength depends on petrographic and mineralogical structure of a meteorite which is a question of the further researches.

Table 2. Anisotropy of mechanical properties of SAUH 001

Name	X	Y	Z
Compressive strength, Mpa	127.59	87.46	93.94
Variation coef., %	15.88	26.30	29.11
Tensile strength, Mpa	16.65	17.68	15.41
Variation coef., %	35.44	31.51	34.89
P-wave, m c^{-1}	3263.5	2953.3	3123.3
Variation coef., %	10.68	12.95	20.86

Summary: The used technique of researches allows to receive enough statistics of measurements and, accordingly, reliable enough data on rather small volume of a material. Besides, the given technique allows investigating dependence of volumetric anisotropy of physical and mechanical properties on structural, mineralogical and petrography characteristics of material. Basically igneous terrestrial rocks are characterized by much higher strength properties than the meteorite. Terrestrial rocks similar on strength properties are few of them - troktolite gabbro-diabase, olivine gabbro, dolerite [10], fine-grained gabbro and serpentinous dunite [11]. But these rocks are characterized by lower values of Poisson coefficient and much higher values of Young modulus. A P-waves speed of the compared terrestrial rocks is larger by factor of two, and for dunite is larger by a factor of three than for the meteorite. There are no analogues among terrestrial igneous and sedimentary rocks and ores on set of physical and mechanical properties of the meteorites (Table 1) [11].

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