WHAT IS THE STATUS OF THE HYPOTHESIS OF EVIDENCE OF BIOGENIC ACTIVITY WITHIN MARTIAN METEORITES: ALIVE OR DEAD? E. K. Gibson Jr.[1], D. S. McKay[1], K. Thomas-Keprta[2], F. Westall[3], and S. J. Clemett[2], [1]Mail Code SN, NASA Johnson Space Center, Houston TX 77058, USA (everett.k.gibson1@jsc.nasa.gov), [2]Mail Code C-23 Lockheed-Martin Corporation, NASA Johnson Space Center, Houston TX 77058, USA, [3]Lunar Planetary Institute, 3600 Bay Area Boulevard, Houston TX 77058, USA.

In August 1996 McKay et al., [1] proposed that the ALH 84001 meteorite contained chemical and physical signatures which, when considered collectively and in their spatial association, were suggestive of evidence for possible primitive life on early Mars. Lines of evidence reported for possible past life were based upon the following: an igneous rock containing carbonate globules which had been deposited by fluids penetrating along fractures; carbonates formed at temperatures below 100°C which contained features thought to resemble terrestrial microorganisms, terrestrial biogenic carbonate structures, or microfossils; biogenic magnetites and sulfides that could have resulted from microbial processes; and, the presence of reduced organic carbon components associated with the carbonate globules.

As with any scientific hypothesis it must stand the test of scrutiny and evaluation over time. After four years of intense scientific investigation which include studies of other martian meteorites, our team feels that the hypothesis that martian meteorites could contain evidence of past biogenic activity is still valid. All four original lines of evidence stand and none of them has been seriously compromised. Carbonate globules are indeed martian in origin and were apparantly formed at temperatures below 80°C. Twenty to twenty-five percent of the magnetites within the globule rims have six unique properties which are characteristic of magnetites produced by magnetotactic bacteria [2]. Carbonate globules contain indigenous reduced C which originated on Mars [3]. Reduced organic components are found dispersed irregularly within the carbonate globules [4]. Both ALH 84001 and Nakhla contain structures which resemble terrestrial bacteria and parts thereof (however, only recently has the problem of terrestrial contamination come to light and we have been at pains to distinguish structures which appear to be indigenous and those which are not).

Any scientific hypothesis must also be able to predict discoveries based upon the original hypothesis. Similar features have been observed within two additional martian meteorites of younger ages. Nakhla (1.3 Ga) and Shergotty (165–300 My) contain microfossil-like features which are essentially identical in size, morphology, and composition to microfossils structures within the terrestrial geologic record [5] . Within Nakhla up to 80% of the reduced carbon components are indigenous and are martian in origin [6]. Hopanes and hopanols within the carbonate globules of ALH 84001 and within Nakhla are possible biomarkers[7]. However, definitive tests as to whether they are indigenous or contamination awaits further work. Such unique biomarkers have been shown to be identical to those measured within known strains of bacteria. Sulfur isotopic variations within the rims of ALH 84001 carbonate globules are similar to those produced by sulfate-reducing bacterial products in the Banded Iron Formations [8]. Evidence for extensive aqueous alteration within the ALH 84001, Nakhla and Shergotty is evident from the abundance of the layer-lattice silicates, now well documented in each of these meteorites. It is clear that as additional research is carried out, new data will be obtained, and it too must be evaluated at to whether it supports or refutes the hypothesis. However, the important thing which must be remembered is that the scientific community will be better prepared to analyzed the returned martian samples during the first quarter of the 21st Century.

References: [1] McKay et al., (1996) *Science, 273,* 924–930. [2] Thomas-Keprta et al. (2000) *GCA,* in press. [3] Clemett et al. (1998) *Faraday Discussions, 109,* 417–436. [4] Flynn et al. (1999) *LPS XXX,* Abstract #1087. [5] Gibson et al. (2000) *Precambrian Res.,* in press. [6] Jull et al. (2000) *GCA,* submitted. [7] Steele et al. (2000) *JGR,* in preparation. [8] Greenwood J. P. et al. (1999). 9th Goldschmidt Conf., pp. 103–104.